OCTOBER, 1953

VOLUME 40
NUMBER 10

plating

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THIRD SESSION PAPERS

See Contents Page 1101

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How do you clean, descale *and* shine roll self-tumbling parts?

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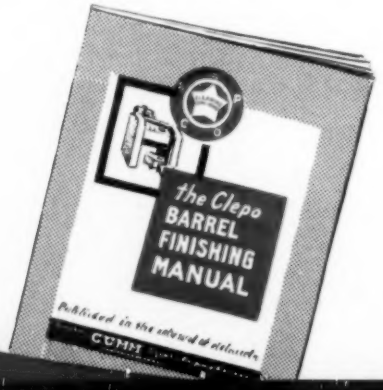

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copper, zinc, steel

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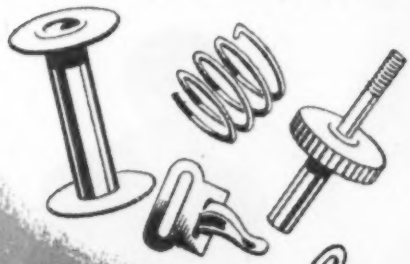

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EBONOL "S" Processes for blackening steel to produce jet-black oxide coatings. Simple and economical to operate. Operating temperatures: EBONOL "S", 285-290°F., EBONOL "S-30", 295-305°F.

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"THESE FACTS AND FIGURES PROVE THAT THE NEW CHANDEYSSON MOTOR-GENERATOR, FOR PLATING OR ANODIZING, COSTS LESS THAN OTHER POWER CONVERSION METHODS" - -

Higher Efficiency—
CONSUMES LESS POWER

The NEW 5,000 amp. 12 volt Chandeysson Motor-Generator, with an *overall* power efficiency of 85% plus, may save upwards from $800.00 a year in power consumption alone, or $9,600.00 in the *first twelve years of its operation**, when compared to units of similar rating used in other power conversion methods. In *overall* cost, the Chandeysson Generator is less . . . in *overall* power efficiency, the Chandeysson Generator is greater!

**Based on power rate of 1¢ per kilowatt hour.*

Better Power Factor —
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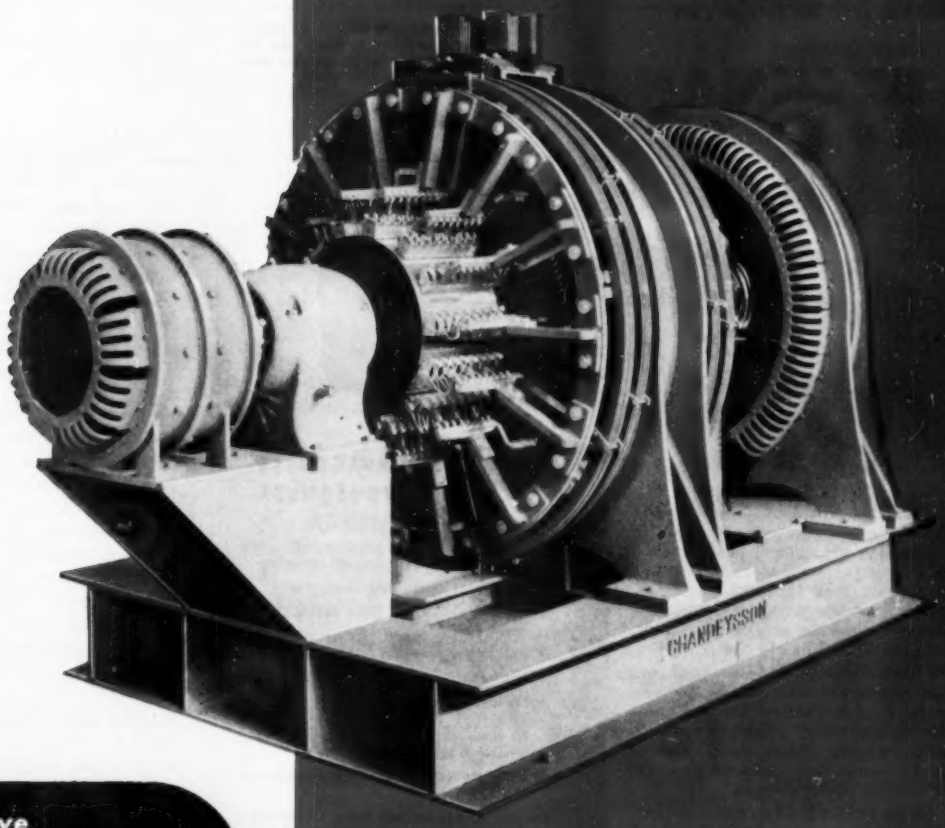
The Chandeysson Synchronous Motor, with a built-in 80% leading or unity power factor, assures you of a remarkably high degree of efficiency. By improving the overall plant power factor from 80% lagging to 90% lagging through installation of a synchronous motor, the NEW Chandeysson Generator will reduce the shop current as much as 11% for the same kilowatt load all along the line! You'll save on power bills and reduce transformer and feeder losses throughout the entire plant!

Tailored Design & Construction —
A LIFE-TIME OF SERVICE

The Chandeysson Motor-Generator, especially designed for the Electrolytic Industry, operates at *peak* efficiency for years and years even under the most adverse conditions. There are Chandeysson Units still in constant use after forty-eight years of service! The Chandeysson Generator will pay for itself over and over again and, regardless of its age, always has a high resale value.



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Chandeysson Motor - Generators have been known to carry loads far in excess of rated capacity for long periods without damage to the unit. They can be counted on to deliver a steady flow of current through intermittent high overloads without the risk of harming the unit or spoiling the work in the tank. Like the Chandeysson name, the Chandeysson Motor - Generator is something you can depend upon!

IT WILL PAY YOU TO INVESTIGATE THE STORY OF THE NEW CHANDEYSSON MOTOR-GENERATOR — WRITE FOR BULLETIN D101; NO OBLIGATION OF COURSE.

Chandeysson ELECTRIC COMPANY
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The *Compact*
completely portable way
to make pH savings...

THE BECKMAN
MODEL N pH METER

There is scarcely a major industry where Beckman pH control has not provided *new* savings, *new* speed, *new* production advantages. And for those plant and field applications where complete portability is desired, no other instrument equals the Beckman Model N pH Meter.

Light, compact, easy-to-operate, here's an instrument with built-in ruggedness to be used anywhere—in orchards, oilfields, textile mills, mining and mill operations, plating shops, food plants, laboratories—*anywhere*, without dependence on outside power circuits.

Never before have so many important advantages been combined into a single pH instrument...

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- Accuracy to better than 0.05 pH.
- Low operating cost—less than 2c per hour.
- Temperature compensation—0° to 100° C.
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- "Check Pointer" eliminates need for frequent buffer standardization.
- Batteries are easily checked with the regular panel controls—no need to disassemble the instrument. Clip-mounting of batteries eliminates need for soldering or wiring.

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- All-metal case—cast aluminum with baked enamel finish to resist wear and corrosion.
- Splash-proof design—fully desiccated.
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- Small, compact—only 4" x 6" x 9½" overall.
- Equipped with the new Beckman Red Label Glass Electrode—virtually unbreakable, covers almost the entire pH range, usable from freezing to boiling.
- By far the most rugged overall construction of any pH meter.

See your nearest Beckman dealer for the complete story on Model N advantages. Or write direct for Data File No. 71-15.

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For Plug-In Convenience the Beckman Model H is unsurpassed. Operates directly from standard 115 v AC power circuits, and can be left on for continuous operation without rechecking and adjusting. Sloping panel facilitates readings—dual-scale dial permits accuracy to 0.03 pH. Built-in temperature compensation and voltage regulator—many other features!

For Laboratory Accuracy the Beckman Model G provides many special features that insure maximum versatility . . . accuracy within 0.02 pH. Completely shielded electrode compartment accommodates wide range of special-purpose electrodes for various pH determinations as well as titrations, oxidation-reduction measurementr, etc.

Let our trained engineers study your operations and make recommendations on the pH equipment best suited to your particular needs. No obligation, of course!

Beckman *division*

BECKMAN INSTRUMENTS, INC.
SOUTH PASADENA, CALIFORNIA

In This Issue

Decomposition of Cyanides in Aqueous Solutions by W. R. Meyer, R. F. Muraca and E. J. Serfass is a paper wherein is detailed the chemistry of cyanide decomposition in electroplating baths. Tabular summaries of experimental work performed to determine the rates of reaction are included in the report.

An Evaluation of Carbonate Removal Methods by R. Scott Modjeska is a paper in which the author reviews four methods: freezing out, chemical precipitation, acid treatment, dilution. From experimental data and observations of plant operations, the author concludes that precipitation with calcium hydrate is the simplest and most efficient removal method.

A Further Study on the Effect of Abrasive Metal Polishing on the Character of Nickel Plate by Walter L. Pinner. The effect of abrasive polishing of steel on the quality of plated nickel thereon is discussed. The presence of steel slivers and fragmented metal are shown to affect smoothness, buffability and corrosion resistance of plated coatings. Certain electrochemical treatments are shown to be beneficial in removing fragmented metal particles prior to plating.

Plating on Molybdenum by A. Korbelak is a report on the use of a chromium-strike technique for obtaining adherent plated coatings on molybdenum. Methods, other than electroplating, for applying coatings to the metal are also described.

A. E. S. Research Report. Project No. 6. XII. Measurement of Surface Roughness and Its Change in Exposure by N. Thon, Ling Yang, and Stella Yang is the latest Project No. 6 paper. It describes a reliable quantitative method for the determination of the true specific surface area of a solid. The application of this method in the study of the surface area of an electrodeposit is outlined. The authors conclude that the method described permits quantitative measurements of the mean roughness of a large area of a deposit, and of its changes under given exposure conditions.

For page numbers, see Table of Contents, page 1101

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There's ONE Grain HERE that's right for YOU

...are you using it?

GRAIN TYPE	CHARACTERISTICS	PRIMARY USES
ALOXITE TP Aluminum Oxide	Tough, blocky. Standard grit sizes from 16 through 220.	Polishing operations involving heavy stock removal on steel and other high tensile strength metals.
ALOXITE TPT Aluminum Oxide	Tough, sharp. Grits 16 through 100.	Polishing operations involving removal of large amounts of metal (e.g. plowshares).
ALOXITE TPL Aluminum Oxide	Very sharp, friable. Grits 16 through 220. (It fractures during use, thus reduces loading of the wheel surface).	Polishing low tensile strength metals—copper, brass, bronze, aluminum.
ALOXITE TPC Aluminum Oxide	Medium sharp. Grits 16 through 220.	General purpose polishing grain—for removal of small amounts of metal.
ALOXITE TPW Aluminum Oxide	Powder. Grits 240 through 1000.	As the abrasive in paste heading of polishing wheels and belts.
CARBORUNDUM RA Silicon Carbide	Sharp, very friable. Grits 10 through 240.	Polishing cast iron.
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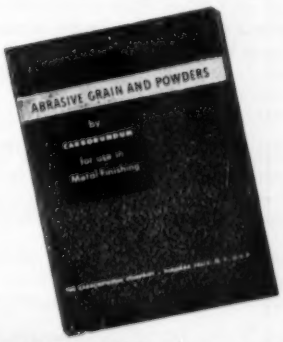
HERE'S THE BOOKLET that tells you everything about the finishing of metals with abrasive grain and powders ... how to size, cast and cure your polishing wheels—how to recondition used wheels, etc. Also full discussion of metal buffing, tumbling, blasting and litho plate graining with abrasives by CARBORUNDUM. Send for your copy today. No charge—no obligation. Just write to Dept. P 83-51.



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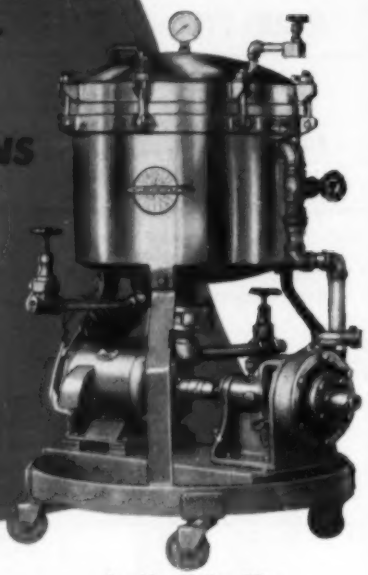
FILTERING OF
PLATING SOLUTIONS
SPARKLER
HORIZONTAL
PLATE
FILTERS



Sparkler Plating Filter
Model 18-D-6 Alliron
600 G.P.H. Portable

HERE'S HOW

★ On a horizontal filter plate it is possible to apply a thin pre-coat with about one-third the filter aid, and in one-third the time required for pre-coating a non rigid media or a surface in a vertical position. This saves time and filter aid.

★ With the Sparkler horizontal plate you can apply this thin pre-coat evenly over the entire plate surface and start filtering immediately with less pressure and obtain maximum consistant clarity right from the start up to the end of the cycle.

★ A filter cake on a horizontal plate will not crack, slip or fall off even with varying pressure or a complete shut-down of the filter. No pre-coat renewal is ever required after an interruption in operation.

★ When it is necessary to clean the filter, the Sparkler filter tank can be emptied in a matter of minutes with a minimum of loss of valuable plating solution.

★ Any grade of filter paper from fine to coarse can be used in a Sparkler filter. This makes it ideal for carbon treatment of solutions. Carbon mixed with water in a stand-by tank is circulated through a clean set of filter paper on the plates until a carbon cake is formed. The solution requiring carbon treatment is then circulated through the carbon beds without contaminating the plating tank or a shutdown of plating operations.

★ At the end of the cycle with a Sparkler filter you can blow-down with air and produce a relatively dry cake that can be disposed of in a trash can rather than washing it down the drain with attendant sewer clogging problems.

★ You will find your Sparkler plating filter positive and dependable from a standpoint of uniform high quality filtering and economical in labor and material.

SPARKLER

Sparkler representatives in all principal cities are ready to give you personal service on your filtering problems, and show how you can make a material saving in operating cost.

MANUFACTURING COMPANY
Mundelein, Illinois

Sparkler International Ltd.
Prinsengracht 876, Amsterdam, Holland

Sparkler Western Hemisphere Corp.
Mundelein, Ill. U.S.A.

Industry News

1955 Convention and Exposition

Plans are being developed at a fast pace for the Convention and Industrial Finishing Exposition of the American Electroplaters' Society to be held in spacious Cleveland Public Auditorium, June 20–23, 1955.

Westbrook

The Executive Board of the American Electroplaters' Society announces that it has contracted with the American Decorating Company, 1349 W. 24th St., Cleveland 13, Ohio to produce the Exposition. Mr. Harold E. Bartlett of that concern has been appointed Exposition Manager to handle space sales, promotion, and to work directly with the Cleveland Industrial Finishing Exposition Committee.

This company and its personnel have successfully managed and produced some of the largest national shows in the country. Theirs is a nation-wide organization with years of experience. Plans are underway to make the Cleveland Exposition the biggest and most successful yet held.

Exposition Committee members are Chairman Leon R. Westbrook, Consultant; Howard H. Blouch, Chromium Corporation of America; Eugene L. Combs, Diamond Alkali Company; Herb E. Head, Briggs Manufacturing Company; Ralph A. Schaefer, Clevite-Brush Development Company; and P. Peter Kovatis, Executive Secretary of the A. E. S.

Bright Nickel Process Sold. Lloyd Portzer, president of Smoothex, Inc., 10705 Briggs Rd., Cleveland 11, Ohio, announces the sale of their super bright nickel process to one of the largest manu-

POSITION AVAILABLE

Plating chemist for job shop plant. Fast growing concern, permanent position. Opportunities. *Reply to:*

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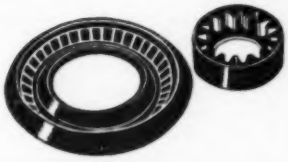

RUGGED SCUFF RESISTANCE

POSITIVE INSULATION

DURABLE PROTECTION

When...

THEY'RE MICCROSOL COATED

They Meet the Highest Industrial Standards

MICCROSOL E-1003 Heat-Cured Rack Coating is a 100% solids, non-evaporating material that produces a smooth, tough, leather-like coating which will often outlast the rack. Exceptional adhesion is achieved through the use of our primers.

In addition to the outstanding characteristics listed above, tests for abrasion and resistance to all commonly used plating solutions, acids, and caustics show superior performance in comparison to similar products. MICCROSOL E-1003 has proven to excell as a coating for materials-handling equipment, baskets, hangers, and a wide variety of plating equipment parts.

MICCROSOL E-1003 has an exceptionally high gloss, allowing free drainage, and no solution carry-over.

We will be pleased to help you with your coating problems. Send us full particulars.

MICCRO Products

MICHIGAN CHROME
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Industry News

facturers of plating processes and equipment in the country, the Udylite Research Corp., Detroit.

This process, utilizing new and different organic agents, was developed by Smoothex, Inc. Smoothex, Inc. will continue its development work on other processes directing the bulk of their efforts to their new bright copper program.

Titeflex Filter Sale To Wagner Bros., Inc. Titeflex Inc., 500 Frelinghuysen Ave., Newark 5, N. J., announces the sale of the design and manufacturing rights of the industrial filter for the electro-plating market to Wagner Bros., Inc., 400 Midland Ave., Detroit 3, Mich. Titeflex still retains the design and manufacturing rights of its filters for the chemical and other industries.

The Titeflex filter features simplified vertical membranes with a unique economical backwash operation.

With the addition of the Titeflex filter, Wagner Bros. will become both manufacturers and distributors of filters and filtration equipment. Wagner Bros. products are anodes, rectifiers, and a complete line of automatic and semi-automatic plating equipment.

Pennsalt's New Calvert Plant Now In Operation. The new $8,000,000 electrolytic chlorine and caustic soda plant at the Calvert City works of the Pennsylvania Salt Manufacturing Co. is now in production, it was announced.

The new DeNora electrolytic cells have been charged with brine made from Louisiana salt and activated with TVA power and now are producing chlorine and high purity, high strength caustic soda. Chlorine and hydrogen from the cells are being combined in the new anhydrous hydrogen chloride unit, and deliveries of these basic chemicals have started.

IAC Meeting of Primary Consumers of Nickel For Chemicals And Electroplating. Removal of all government controls "as soon as practical" on the civilian use of nickel was recommended unanimously by the Industry Advisory Committee of Primary Consumers of nickel for chemicals and electroplating, at a meeting with the National Production Authority, Department of Commerce.

The committee recommendation referred only to the supply remaining after all Defense and AEC requirements had been met in full. It was estimated by NPA officials that about 40 per cent of the total supply was needed for defense purposes, excluding stockpile requirements.

Government officials emphasized that the proposal for decontrol of nickel is under consideration and would be discussed thoroughly with all other defense agencies before recommendations were made to the Office of Defense Mobilization.

NPA officials emphasized that in the event nickel was decontrolled, that action, in itself, would not increase the amount of nickel for civilian consumption and that the primary responsibility of government and industry was to see to it that the requirements of defense and Atomic Energy were met in full.

New Home for Sall Metals Co. The George Sall Metals Company, Inc., has opened its new offices and smelting plant located at 2300 E. Butler St., Philadelphia, Pa.

FREE

— yours for the asking

Every electroplating shop interested in better plating can use the new MAGNUSON handy pocket-size Electroplater's Cleaning Manual.

Packed with valuable information, and indexed for quick reference.

The supply is limited — we suggest you write for your copy or copies today.

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Sustaining Members

Reports of additional AES Research memberships from Canada have been sent in to AES Headquarters. The two organizations, whose dues are added to those other 350 memberships in support of the Society Research Program are:

Canadian Westinghouse Company, Ltd., Hamilton, Ontario;

Empire Brass Manufacturing Company, Ltd., London, Ontario.

GERMAN ELECTROPLATING SPECIALIST

—doctors degree—extensive experience in research and development. Likes to immigrate to the USA. Asking for position and company as sponsor. *Reply to:*

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Completely Sealed — Water Cooled

PLATING RECTIFIERS

- *Never Needs Cleaning*
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Greater flexibility and control . . . dependable efficiency . . . these are characteristics of every Sel-Rex Selenium Rectifier.

Hundreds of major installations — more than 3,000,000 amperes of dependable D.C. power — are a tribute to the quality and efficiency of Sel-Rex Rectifiers for day-in, day-out top performance under all conditions.

Before you buy any D.C. power source, be sure that it has *all* these features!

REACTRONICS — Completely eliminates moving parts . . . maintains constant voltage across the bus bars or constant rate of current flow through the bus bar.

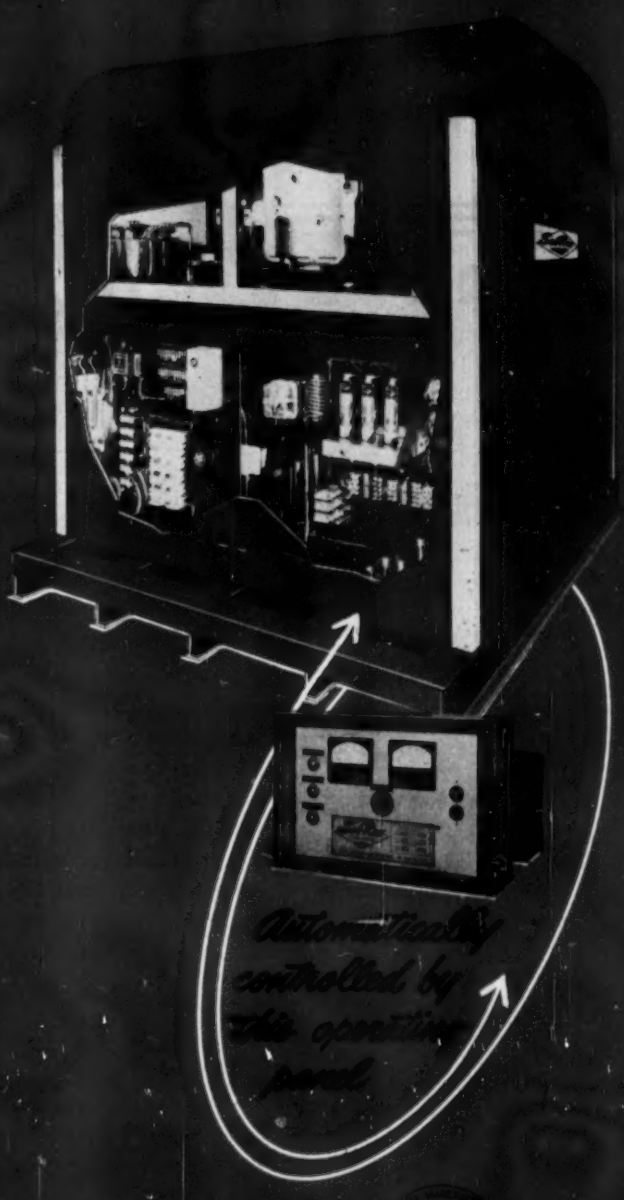
TRANSFORMERS — Conservatively rated, heavy duty 3 phase, protected for use in highly corrosive atmospheres. Constructed and insulated with the finest materials.

METERS — Highest quality Weston meters, with large dials for easy, accurate reading, are standard equipment on all Sel-Rex units.

POSITIVE OVERLOAD PROTECTION — Unit shuts off automatically when output current exceeds rated value.

For absolute protection against corrosion plus the many other advantages that assure dependable, efficient D.C. power — specify Sel-Rex, the only Rectifier fully covered by a TWO YEAR guarantee.

Write for your FREE copy of "PLATING POWER"



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NEMA

A COMPLETE RECTIFIER LINE ... FROM 25 to 50,000 AMPERES

Industry News

DeVilbiss Expands Metal Working Division. Expansion of the metal working division of the DeVilbiss Company has been announced.

To handle the company's expanding business in the spray booth field, an addition is being built on to the present building occupied by the sheet metal division. The new steel-frame and masonry structure will give the company additional space for manufacturing, storage and shipping.

Engineering Activities Enlarged. The firm of Joseph Mazia Consulting Engineers, 1424 K St., N. W., Washington 5, D. C., has enlarged its scope of activities by being appointed special technical representative of Gray Company, Inc., Minneapolis, Minn., manufacturers of special equipment used in the fields of protective coatings and lubrication.

Addition of the Graco line will complement the work now being done by the Mazia firm on behalf of American Chemical Paint Company, Stoner-Mudge, Inc., and Orchard Brothers, Inc.

Daryle H. Busch, Fellowship Winner. Dr. Arthur E. Martell, Chairman of the Selection and Advisory Committee and Professor of Chemistry at Clark University, announced that the first Bersworth Fellowship in Chelate Chemistry has been awarded to Daryle H. Busch, a graduate chemistry major at the University of Illinois. The fellowship carries a stipend of $3,500 and will provide the recipient with one year of graduate study and research on metal chelates at the University of Illinois.

Busch received his B.A. from Southern Illinois in 1951 and his M.S. from the University of Illinois in 1952.

The fellowship is the first of its kind in America and was established by Dr. F. C. Bersworth, of the Bersworth Chemical Company, Framingham, Mass.

Enthone Office Building Completed. Enthone, Inc., New Haven, Conn., has completed interior and exterior work on their new office building. This is part of their expansion and modernization program. The illustration shows the modern-

ized-front view with its extended use of glass block and tempered glass entrance to blend with the ornamental brick structure.

Improvements within this building consist of additional offices in the modern design for officials and general office personnel and refurbishing of all other offices to allow for the company's increase in technical and general personnel.

Name Change. The name of the Topper Equipment Company, manufacturers of vapor degreasers and other metal cleaners and solvents, has been changed to the Circo Equipment Co. The company is located at 120 Central Ave., Clark Township (Rahway), New Jersey.

Equipment produced by the company previously has borne the trade name Circo and the change in company title acknowledges the recognition of Circo products through 30 years of experience in the metal-cleaning field. With the name change, both products and company designation will be Circo.

BRASS PLATING WITH TRUE BRITE

❶ improve color

❷ save labor

❸ eliminate supervision

❶ *color stays constant . . . no rejects*

❷ *eliminates frequent analyses . . .*

❸ *trouble free . . . only one addition instead of three*

Write for FREE bulletin! Your key to better Brass Plating

Available in regular 3 to 1 ratio for yellow Brass Plating.

Special ratio materials for plating richlow brass or any other desired alloy of copper and zinc.

Suitable for both still tanks and barrels.

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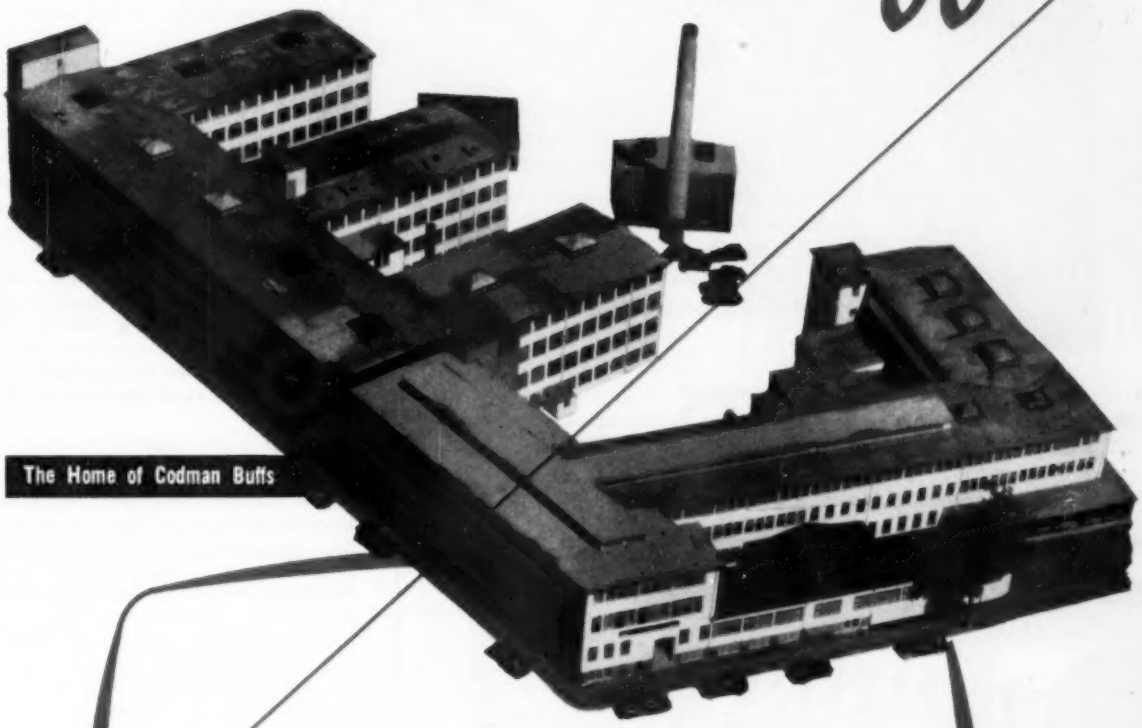
Distributors, Jobbers and Manufacturers Agents to distribute and sell the full line of Schaffner's Polishing and Buffing Composition in Bar, Spray or paste form and a complete line of supplies.

Schaffner Manufacturing Company, Inc.
Emsworth, Pittsburgh 2, Pa.

CODMAN

the greatest name in Buffs*



* For over a half century, the Codman Company has been producing a most complete line of buffs and polishing wheels. • During this period, Codman has pioneered in the development of products to meet the exacting needs of the metal finishing industry. This program has been possible because the efforts of the company have been devoted *exclusively* to the design, development and manufacturing of buffs and polishing wheels. • Acknowledgment and thanks are hereby given to our customers who have offered their time, efforts and plant facilities in aiding us to better our products.

F. L. & J. C. CODMAN COMPANY Rockland, Massachusetts

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STORTS High Production ANODES

will stretch your anode dollars

The anodes shown were specially designed and fabricated for long work—and for long life. For the general run of work, Storts perforated lead and steel anodes of conventional design are made in any desired length and with a variety of hook combinations. Specials are a specialty. Consult us on all your needs in lead or steel anodes.

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Manufacturers of Welded Fabrications to Specification

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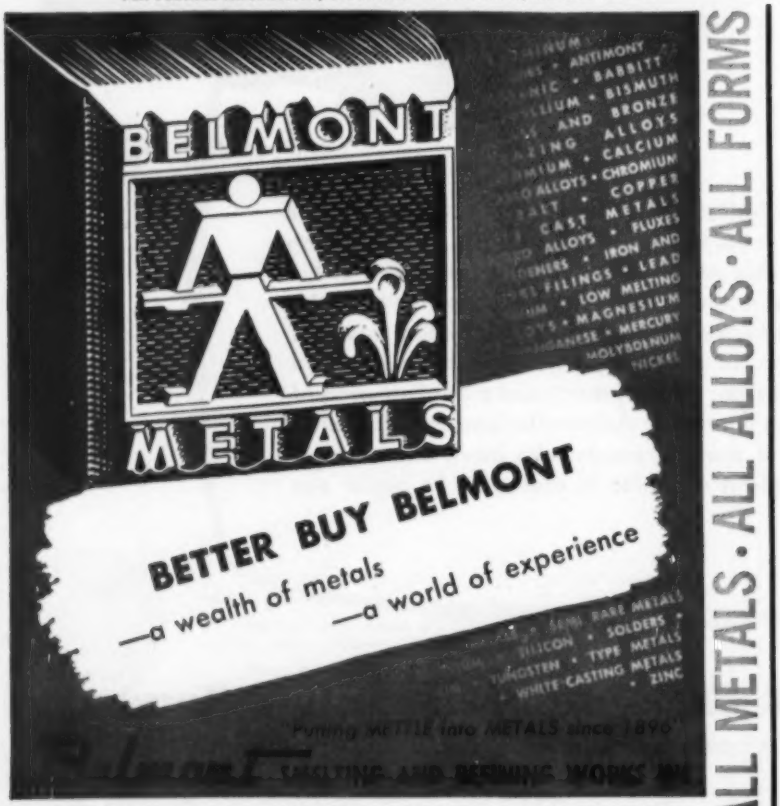


306 Belmont Avenue, Brooklyn 7, N. Y. Dickens 2-4900

Industry News

Electroplating Step May Improve Galvanizing Process. Electroplated films may be used to improve the process of hot galvanizing strip steel by protecting the treated surfaces of the steel prior to coating. This is the opinion of Allen T. Baldwin, Hanson-Van Winkle-Munning Co., Matawan, N. J., who has completed experimental studies on hot galvanized coatings.

Any steel surface must be completely free of oxide and non-metallic materials before galvanizing. If it is not, molten zinc will not alloy with the ferrous surface. Surfaces can be freed of iron-oxide by ordinary pickling. But under ordinary conditions, particularly where continuous methods are in use, iron surfaces tend strongly to re-oxidize.

"We've found," Baldwin explains, "that a film of non-ferrous metal plated to the ferrous surface can retard, and possibly prevent the formation of any iron oxide on the surface. The film itself might oxidize, but these oxides would not have as harmful an effect."

Rampe Manufacturing Company Opens Additional Factory. Due to the large increase in sales of their line of tumbling and deburring equipment, Rampe Manufacturing Co., 3320 St. Clair Ave., Cleveland, Ohio, have found it necessary to open an additional plant since they could not expand at their present location. The additional factory is located at 8404 St. Clair Ave., Cleveland, where they are concentrating the manufacture of all tumbling equipment. All other products still are manufactured in the original factory.

FOREMAN FOR ANODIZING DIVISION

Anodizing Foreman needed for Decorative Trim Manufacturer located in Chicago. Submit experience in detail. Replies held confidential. Reply to

P-1053-C, PLATING
445 Broad St., Newark 2, N. J.

2 PLATERS WANTED

If you are looking for a future and not over 50 years of age, and have experience in Silver, Copper, Nickel and Chrome plating. *Write or apply to:*

CROWN PLATING WORKS
806-812 Rosselle St.
Jacksonville 4, Florida

The palm tree that grows in Ohio

They planted it a year ago.
Leading steel publications covered the story:

"New All-American Lubricant For Cold Rolling Operations"

That's how The Ironsides Company of Columbus, Ohio, announced the first successful replacement for palm oil.

Instead of relying on palm trees—half a world away, tin plate producers now have a "palm tree" right in their own back yard.

Palmoshield looks, feels and acts like palm oil; requires absolutely no changes in mill operation. Already most of the major tin plate mills in this country and Canada are using Palmoshield for regular mill operations or for production test runs.

. . . and grows and grows and grows!

Production records set with Palmoshield: Recently a leading steel company, over a run of 20 consecutive shifts, increased production 15% over the average output with imported oil. No additional investment, no increase in manpower, and no changes in mill operation. Yet 115 tons of steel were rolled for every 110 before. One company broke the single-shift record, and still another broke both 8-hour and 24-hour records.

Backed by 60 years of specialization: Palmoshield is the result of Ironsides' sixty years of specialized research in the field of scientific lubrication. For your own lubricating problems, call or write The Ironsides Company, 270 West Mound Street, Columbus, Ohio.

SPECIAL LUBRICANTS and PRESERVATIVES

SHIELD PRODUCTS

IRONSIDES PALMOSHIELD

Industry News

New Distributor for "Honite". Appointment of Metals Finishing Corporation, 836 E. Tenmile Rd., Hazel Park, Mich., as distributor for the "Honite" line of barrel finishing products, has been announced by the manufacturer, Minnesota Mining and Manufacturing Company, St. Paul, Minn.

The firm, headed by Mr. Harvey Beggs, President, has operated a barrel finishing shop for the past eight years. Sales manager for the company is Mr. Cranston Jones.

Serving adjacent areas of Ohio and Indiana as well as the state of Michigan, the firm will distribute "Honite" barrel finishing equipment, "Honite" and "Super Honite" chips and "Honite" compounds.

New Customer Service Warehouse. A new service to Ohio customers of Frederic B. Stevens, Inc., has been inaugurated with the opening of a customer service warehouse in Springfield, Ohio.

Customers in the Ohio area were notified of the contemplated move and, through the use of convenient postage paid return post cards, were given the opportunity to specify items they would like stocked.

The warehouse is being operated in conjunction with the Stevens plant in Springfield.

Firm Organized To Locate Technical Books. Announcement is made of the formation of "Tradebooks of Connecticut", 488 Winthrop Ave., New Haven 11, Conn. The firm is organized to supply trade and technical books and will maintain a free engineering service to locate hard-to-find technical books. This service includes finding books of technical matter where the title, author and publisher is unknown. Many readers, particularly those in industry, find it difficult to locate their needs in libraries, because of limited supplies and local book stores who fail to carry important titles. "Tradebooks" will seek out these wants, regardless of category.

Rectifier Corporation Opens Puerto Rican Plant. Announcement was made recently that Rectifier Corporation of Puerto Rico began operations in a new plant located in Fajardo. The new company has been incorporated under the Island's laws to manufacture selenium rectifiers and related electronic equipment.

Loyd J. Hughlett, president of the new company, announced that the plant's facilities have been organized to produce a complete line of radio stacks for radio and television receivers and comparable equipment requiring current conversion. Markets will be on the Mainland, and delivery from the Island to points on the Eastern seaboard and Midwest can be as rapid as from suppliers in the States.

New Nox-Rust Plant. The Nox-Rust Chemical Corp., Chicago, has been completely installed in its new plant at 47th St. and Central Ave., according to an announcement by George A. Daubert, President.

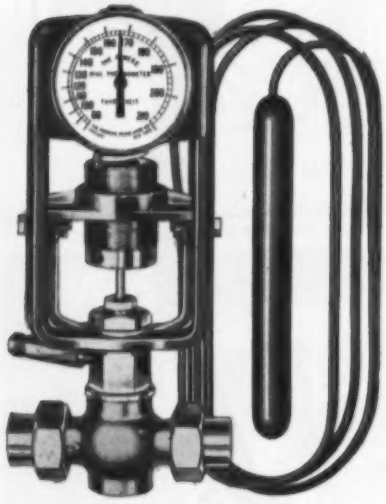
The new manufacturing facilities of the ultra-modern plant, situated on approximately 15 acres of land on Chicago's outskirts, will enable Nox-Rust to step-up production about 100 per cent.

At the same time the executive and sales offices were moved into a new downtown location at 333 North Michigan Avenue.

Singleton and General Supply Join Forces. The ideal combination of electrochemical equipment manufacturing with nation-wide distribution was achieved by the merging of Singleton Company, formerly at 10516 Western Avenue, Cleveland, Ohio, with the General Supply Company, 5317 St. Clair Avenue, Cleveland, Ohio, according to T. R. Gill, Vice President and General Manager of the latter firm.

Albert Singleton continues as president of the manufacturing concern which is incorporated separately in the new set-up as The Singleton Company, and now conveniently located with General Supply at 5317 St. Clair Avenue. Other officers of the new corporation are E. F. Buescher, Vice President; T. R. Gill, Treasurer; and G. A. Singleton, Secretary. The unification of facilities is designed to improve operating efficiency and service to customers of both firms.

Pyrene Makes Aluminum Hard as Steel. A process for making the surface of aluminum file-hard and more resistant to wear than chromium plating or hard-



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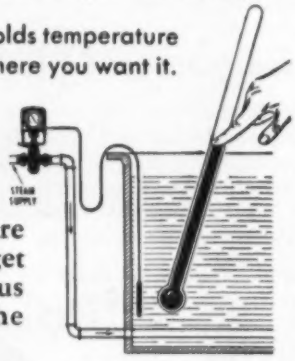


Saves LABOR and Steam
Helps Eliminate Costly Rejects

Powers No. 11-MF Regulators are self-operating. They will help you get the most effective use from various solutions by holding them at the right temperature automatically.

Plastic Covered Thermal Bulb and Tubing—is highly resistant to solutions in above processes. Prevents electrical shorts. No insulators required for the regulator.

Easy to Read 4" Dial Thermometer—indicates temperature of liquid being controlled and makes it easy to adjust regulator for different temperatures.

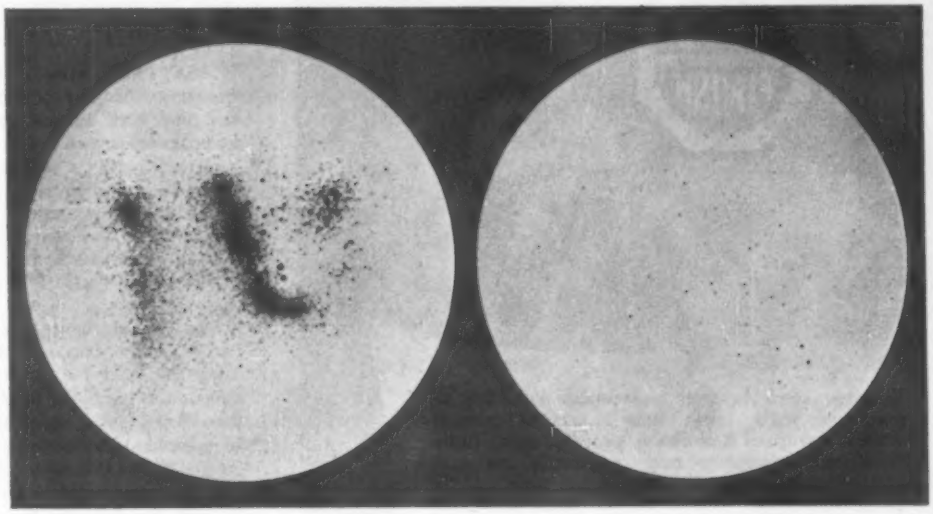
Bulletin 330 describes this simple, dependable control. May we send you a copy? (b31)

THE POWERS REGULATOR CO., SKOKIE, ILL.
Offices in over 50 Cities, see your Phone Book • Established in 1891

HOW TO MINIMIZE HEALTH HAZARDS
In Chrome Plating!

Recent medical investigation has indicated that the harmful effects of chrome fumes may extend to vital organs of the human body and not simply to attack of the nasal septum. The insidious result is that the effects may be cumulative over a long period of time, and continued exposure may be extremely serious.

Fortunately, there is a soluble addition agent, NO-CRO-MIST® which when used in conjunction with requisite ventilation, is effective in keeping the chrome fumes below the known harmful concentration in the atmosphere. NO-CRO-MIST has been available for more than five years and is used in many thousands of gallons of chrome baths with amazing efficiency.



Normal Chrome Mist

NO-CRO-MIST® Bath
(No Chromic Acid Mist)

The above unretouched photograph of the Paper Test of Mist from Chrome Baths was first published in October, 1947. It illustrates the remarkable effectiveness of NO-CRO-MIST in reducing chrome spray before the present, even more effective NO-CRO-MIST was developed.

NO-CRO-MIST is not expensive to use because it saves chromic acid and reduces maintenance costs, but any product cost is insignificant when it results in improved working and health conditions.

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Please send copy of the Summary On Chromium Intoxication and complete information on **NO-CRO-MIST®**

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Company.....
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Industry News

ened steel has been installed by the Metal Finishing Division of the Pyrene Manufacturing Company, 10 Empire Street, Newark, N. J., according to L. E. Eckelmann, Vice President. This process known as Alcoa hardcoat or Martin Hardcoat is being used extensively in the aircraft industry where the combination of light weight and a wear-resistant surface is required. The Pyrene plant already is handling a sizeable volume of contract work for manufacturers in the greater metropolitan area.

MSA Picks Atlas. Atlas Mineral Products Company announces that its firm had been selected by the Mutual Security Agency of the U. S. State Department to hold a seminar and demonstrations for participants for Group II of TA-OEEC-130 on corrosion problems and prevention in the chemical and petroleum chemical industries light chemical group at Mertztown, Pa.

The Nickel Situation. The News Letter of the National Association of Metal Finishers, Inc., states that though something may break at any minute on the nickel situation, nothing definite can be reported at this writing. However, the NAMF Nickel Committee met in Detroit and after considerable discussion, it came up with the following recommendations which were presented to Department of Commerce officials.

1. Continue the allotment of nickel because: (a) of insufficient supply, (b) requirements of the defense effort, and (c) to assure an equitable distribution of the metal.

2. Revoke the use restriction because: (a) of the varied use requirement of the industry throughout the country, (b) hardship of practicability in operation, (c) endangering the life of the industry, (d) it is discriminatory, (e) no such restriction applied to cobalt and other metals which were in short supply, and (f) it interferes with the industry stretching its allotment to the best advantage.

3. Presently established companies in the job plating industry threatened with failure should not be further effected by a reduction in their allotments of nickel made available to new concerns and newly acquired operations.

4. The job plating industry should be allowed 75 per cent of base period quotas, (a) to alleviate the unemployment situation of remaining employees, and (b) to relieve the distress of unprofitable operations to the industry caused by insufficient nickel.

5. Retain hardship clause for current users.

6. All nickel purchased must be for use and not for resale to prevent black market operations now evident.

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Here's why...

TYGON's outstanding resistance to acids and alkalies permits its use in all the usual lining and covering jobs.

TYGON's unique resistance to oxidizing acids, oils, greases, and solvents makes possible its use in jobs other linings cannot handle.

TYGON's flexibility permits close conformance, resulting in a good bond, to all but the most intricately shaped equipment.

TYGON's resilience minimizes the possibility of damage from mechanical abuse.

TYGON's elasticity permits thermal contraction and expansion without rupture.

TYGON's abrasion resistance withstands the wearing action of thick slurries and dry or moist chemicals.

TYGON's negligible extractibility prevents contamination of the most sensitive solutions.

TYGON's availability in white (compound TL-104), as well as standard black, permits its use where solution visibility is highly important.

TYGON's high electrical resistivity prevents current losses in electrolytic action.

TYGON's smooth, non-porous surface makes for easier cleaning and greater solution flow.

TYGON's thermoplasticity permits the "heat-sealing" of seams to form continuous, one-piece, impermeable linings.

TYGON's selective solvent sensitivity eliminates the "need" for curing to obtain a strong bond — makes possible installations of virtually any size — simplifies field repairs.

TYGON's non-oxidizing characteristics give it a long service life.

And remember, Tygon linings can be installed by a licensed Tygon applicator near you—with major savings in time and money.

Write, right now, for more information! Ask for our new 12-page booklet on TYGON LININGS— Bulletin TL-526. It's packed with facts and figures.

Here's how...

Tank is sandblasted before lining.

Special cements are used.

Thick TYGON sheeting is applied.

Joints are "strip-sealed."

Entire lining is "spark-tested."

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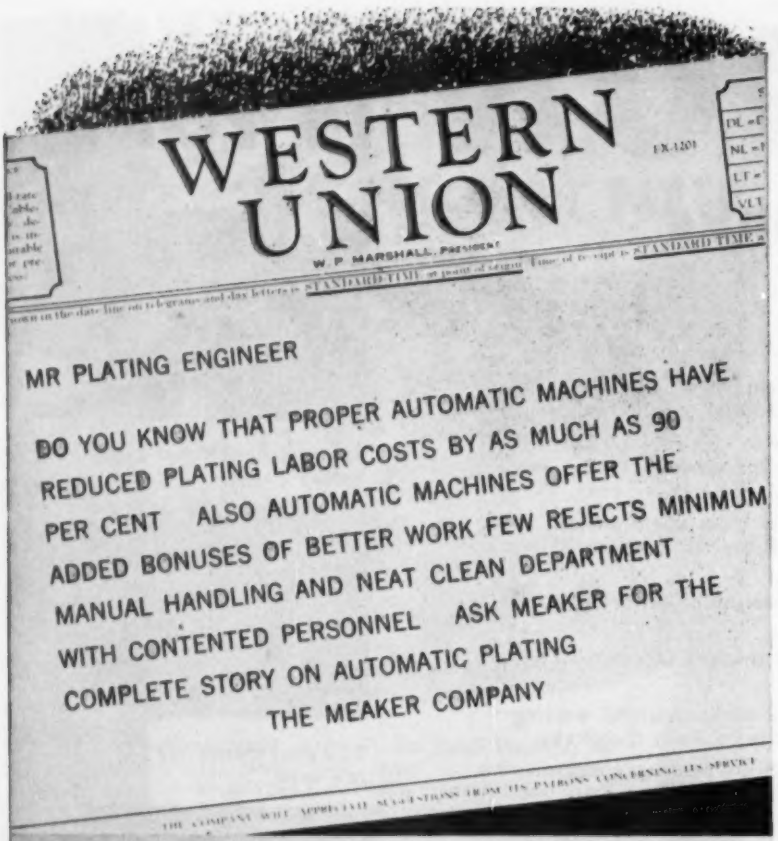
PROCESS EQUIPMENT DIVISION

158-B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REDUCED PLATING LABOR COSTS BY AS MUCH AS 90
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Intersociety News

Institute of Metal Finishing

The Institute of Metal Finishing announces that the following have been elected to the Council for 1953–1954: President, J. W. Cuthbertson; Immediate Past President, H. Silman; Vice-Presidents, S. G. Clarke, G. E. Gardam, R. A. F. Hammond, T. P. Hoar, F. Mason, R. W. Nicol, E. A. Ollard, C. Wharrad; Secretary, S. Wernick; Treasurer, F. L. James.

National Association of Metal Finishers

At a special meeting of the NAMF Executive Committee five members of the Board of Directors were officially appointed to the Executive Committee.

The committee as appointed consists of: Paul E. Miller, President and Chairman; William F. Walton, First Vice-President; C. R. Wheeler, Second Vice-President; Arthur Pierdon, Treasurer; John Hilfinger, Past President.

Arthur G. Pierdon was elected to the Board of Directors to fill the vacancy created by the resignation of Glenn Friedt, Jr., of United Platers, Inc., who was unable to accept the position.

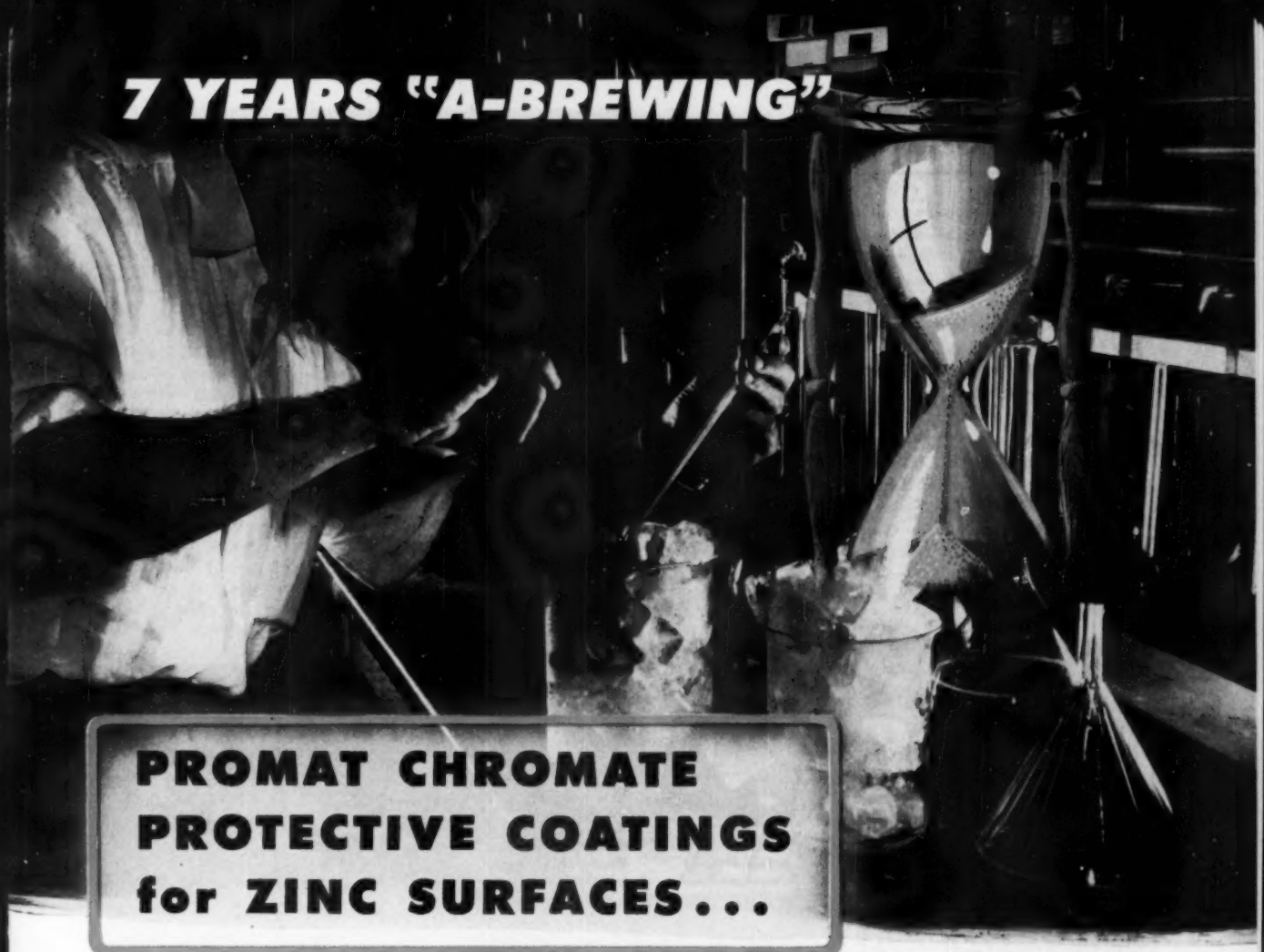
Electrochemical Society

Nathaniel H. Furman, Professor of Chemistry and Chairman of the Department of Chemistry at Princeton University, was awarded the 1953 Palladium Medal of the Electrochemical Society. The award was conferred for outstanding contributions to the field of analytical chemistry and particularly for his successful application of electrochemical principles to the development of new methods and techniques of chemical analysis.

American Society for Testing Materials

The A. S. T. M. announces the publication of a 64-page symposium on Continuous Analysis of Industrial Water and Industrial Waste Water.

Industry, having recognized water as an essential engineering material, is frequently called upon to evaluate its properties, both from the standpoint of its use and its disposal. Precise analytical determinations are necessary if equipment is to function properly, and the frequency of sampling and analysis has become great. Continuous analysis has therefore become essential, and with the present day increase in labor costs, emphasis is being placed on the use of automatic equipment. It is with this need in mind that A. S. T. M. Committee D-19 on Industrial Water developed this symposium.



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PROSEAL No. 1 and 3—Brightening and protection of plated zinc at its maximum efficiency ... always sealed by Proseal 2-A or 2-B... heavy fixed chrome deposit with minimum iridescence ... double immersion.

PROSEAL 6—Ready-to-use process... dilute to strength and start operation ... no acid addition required. Produces a mirror-bright finish over plated zinc when subsequently sealed... yellow or bronze finish over plated zinc is also obtainable ... very inexpensive.

PROSEAL 2080—Dark film of low reflecting power ... high corrosion resistance ... meets all specifications for chrome-type protective films ... inexpensive and very workable.

PROMAT D-32-A—Inexpensive means of producing brilliant protected surfaces on plated zinc ... used as a final finish.

PROSEAL 9—Dry chromate to which only water and acids are added... inexpensively producing a mirror-bright finish over plated zinc or cadmium when subsequently sealed or leached... olive drab and bronze finish are also obtainable.

... other protective coatings described in brochure.

BETTER PRODUCTS don't just happen. They're the result of intensive research and testing. That was the case with Promat Chromate Protective Coatings for zinc surfaces. They were seven years in the lab and field, being developed and tested.

That's why we can say Promat Chromate protective coatings are equal to, or excel, any product offered for a similar purpose ... and you can believe it.*

Promat protective films are unique, "open" process treatments. Full analytical procedures for maintaining the solutions are published. You get more "mileage" as a result, and the films produced are unusally uniform. All the Promat Chromate Protective coatings listed, left, can be used on cadmium deposits as well as zinc. Write today for brochure describing the complete Promat line of plating supplies.

**Promat has the finest demonstration lab in the metal finishing trade. We're always glad to process any samples submitted to us.*

PROMAT **DIVISION** **POOR & COMPANY**
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INDICATE A 1119.

Personals

Warren A. Tipton has been appointed general sales manager of the mechanical goods division, United States Rubber Company, succeeding **Walter F. Spoerl,** who is retiring after 45 years of service.

A graduate mechanical engineer from the University of Illinois, Tipton joined U. S. Rubber as a salesman in its Houston, Texas, branch in 1935. In 1937 he was named product manager for industrial packings and expansion joints. In 1942 he was appointed district sales manager for the mechanical goods division's New York branch and in 1949 was named manager of all branch sales with headquarters in the division's executive offices in Rockefeller Center. He became sales manager of the mechanical goods division in 1952.

Henry S. Curtis has been promoted to the post of Manager of Production and Engineering of the Diamond Alkali Organic Chemicals Division, Inc. Curtis will make his headquarters at the Organic Chemicals Division's plant at Houston, Texas.

The new manager has a broad background in the chemical industry. A native of Parkersburg, W. Va., he received his Bachelor of Science degree in Chemical Engineering from Ohio State University in 1933, and for nine years thereafter was employed in various operating and engineering capacities by the Westvaco Chemical Division of the Food Machinery and Chemical Corporation at So. Charleston, W. Va.

Following military service, Curtis was plant manager from 1946 until 1950 of the new vinyl chloride plant then owned and operated by the Glenn L. Martin Company in Painesville, (Ohio) and continued in charge of the operation following its acquisition by the United States Rubber Company.

He joined the Diamond organization in January, 1951, when he was named assistant general superintendent at the government-owned magnesium plant operated in Painesville by Diamond Magnesium Company, a subsidiary of Diamond Alkali. In August the following year, he was appointed chief engineer of Diamond's newly formed Organic Chemicals Division.

Stanley Beauregard has been appointed by the J. C. Miller Company of Grand Rapids, Mich., as sales representative. Beauregard will represent Miller finishing supplies and equipment in the Eastern part of Michigan with offices at 3829 E. Seven Mile Rd., Detroit. Prior to his affiliation with the J. C. Miller Company, he was associated with the U. S. Rubber Company and was active later as an official of the Willow Run Rubber Company.

Beauregard

Carr

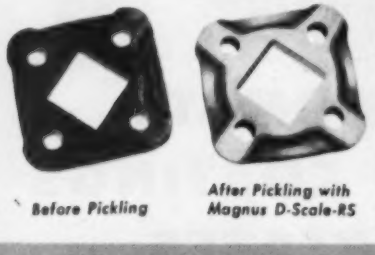
Also announced was the appointment of **Louis E. Carr** as sales representative. Carr will represent the company in the state of Wisconsin and will make his headquarters in Milwaukee. He is a graduate of Purdue University holding B.S. and M.E. degrees. Prior to representing the Miller Company, he was associated with the A. O. Smith Corp. and Rutenberg Electric Company.

David M. Roney, Jr., has been named sales manager for the Electroplating Projects Department of Westinghouse Electric Corporation.

Roney will be responsible for all electroplating sales activities and will be located in East Pittsburgh, Pa.

He came to Westinghouse in 1951, and before his new appointment was an application engineer in the Special Products Development Division. In 1943 he graduated from the United States Naval Academy and until 1948 was on active duty with the Navy. He then joined the Bendix Corporation in Detroit and later took graduate work at the University of Pittsburgh.

USE A SAFE ACID



For FASTER Rust Removal and Descaling

You have to use acids for effective pickling. But you do NOT have to face the hazards of strong mineral acids!

This SAFE Acid Does a FASTER Job!

Eliminate the difficulties in handling and storing strong mineral acids like sulfuric and muriatic. Stop paying for wastage when these acids "over" pickle or otherwise damage the metal being cleaned.

Magnus D-Scale-RS is shipped as a crystalline powder. It stays safe and inert until you dissolve it. Then it becomes a speedy, sure and safe pickling acid. It is inhibited against attack on the metal being treated, attacking only scale and rust and removing them in record time.

Magnus D-Scale-RS is used in cold as well as in hot solution and in tumbling barrels as well as in tanks.

Write for Bulletin 36 on Safe, Fumeless, High Speed Descaling and Derusting

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MAGNUS CHEMICAL CO., INC.
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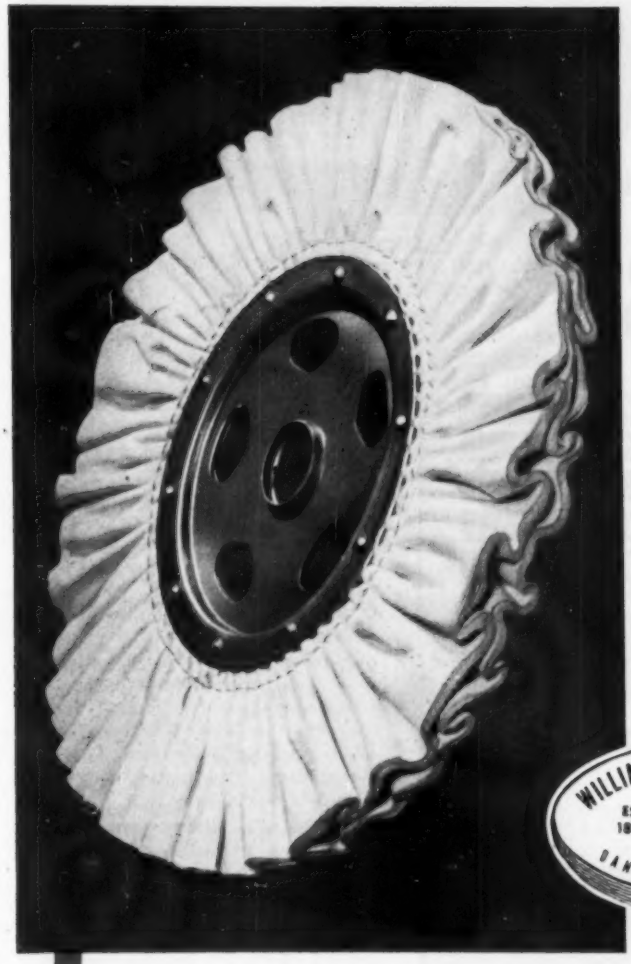
Service Representatives in Principal Cities



Take a Good Look at

Williamsville's *New* CUTMASTER

for Automatic Buffing!

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EST 1893 A1 ®
DANIELSON CONNECTICUT

Cut on the bias for long, rugged service

Steel center is perforated for cool running

Engineered throughout for perfect balance

Let us rush you full details of how the new CUTMASTER can cut your automatic buffing cost now — write, wire or phone!

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The Mutual name and trade mark on a Chromic Acid drum guarantee a product with a minimum assay of 99.75% and a sulfate content not exceeding 0.1%. Chromic Acid of that purity may be used with confidence in any of the applications shown here.

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USE **HEIL** SUPER ANODES

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Other Heil Products include:

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FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A 1123.

Personals

Albert Hirsch, Philadelphia Branch member, and chairman of the Plant Visitations Committee for the recent Phila-

Hirsch

delphia meeting, is recovering from a heart attack and although forced to become inactive as a plater is still active as an A. E. S. member.

John R. Morris has been named by R. O. Hull & Company, Inc., Rocky River, Ohio, as service engineer covering the territory of the New England states, eastern New York, eastern Pennsylvania, New Jersey and Delaware. He will work in conjunction with the sales and service engineering staff of Enthone, Inc., New Haven, Conn. Morris' headquarters will be in New Haven.

Previous to his new assignment, Morris spent several years engaged in the laboratory and manufacturing operations at the Hull Company.

John J. O'Day has been appointed sales representative for the Detroit area by the Hanson-Van Winkle-Munning Company Matawan, N. J.

O'Day

O'Day has been with the company for 1½ years, having previously worked as a chemist with the Food and Drug Administration. He is a graduate of St. Peters College, Jersey City.

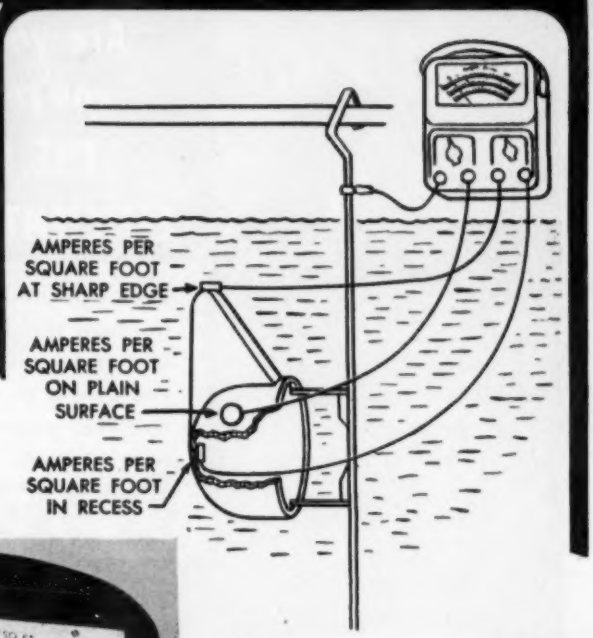
Don A. Lawless, a specialist with 25 years of experience with light metals, has been named assistant director of the metallurgy department of Sam Tour & Co., Inc., New York City

Prior to joining the consulting firm, Lawless was employed at the Kaiser Aluminum and Chemical Corp., where he

Measure Current Density at the Plating Surface

Now you can know *what goes on at the plating surface* to save time and money a dozen ways! Know where you are plating too fast or too slow — instantly read current density at different points with the article in every conceivable position, with various voltages and with different solutions—check throwing power of the solution instantly without analysis or figuring.

The BELKE-KOTZ Current Density Meter is a veritable watch-dog against plating room waste. Enables you to utilize all your experience and skill in plating to specifications, speeding production, saving time, saving metal, eliminating rejects, etc.



BELKE-KOTZ Current Density Meter

Measures current density in amperes per square foot at desired points on the article under actual plating conditions.

Three test leads permit testing at three selected areas without moving test discs.

Nine scales—0-3, 15, 30, 75, 150, 300, 750, 1500, 3000 amperes per square foot assure sharp readings in any range.

Disc Contacts and Range Selector Switches permit instant reading of current density at any test point on any scale.

Patent Pending

Simple as ABC

With the BELKE-KOTZ Current Density Meter it's easy to know instantly what goes on at the plating surface under any condition.

Just attach a test disc at each of three selected areas on the article.

- Position the article in the tank.
- Connect Meter to cathode. Turn switches and read current density at each of the three test areas.
- You can reposition article, doctor solution, or change voltage and read current density quickly until you get the best combination of position, solution and voltage.
- No figuring. Meter is calibrated in amperes per square foot. You can compare the reading with current density tables for the solution you are using.

Ask your BELKE Service Engineer for particulars or send for literature.

Helps 6 important ways—

1. Enables you to instantly compute plating time for any metal thickness at any point on any article.
2. Shows best position for the article.
3. Shows when auxiliary anodes are needed.
4. Shows when burning bars are needed.
5. Shows when voltage is too high or too low.
6. Shows change in solution throwing power.

Belke MANUFACTURING CO.
947 N. Cicero Ave.
Chicago 51, Ill
EVERYTHING FOR PLATING PLANTS

Are you SURE you're using THE MOST EFFICIENT FINISH?

If your production involves finishing zinc, cadmium, aluminum or cuprous metals, you owe it to yourself... and your customers... to investigate

IRIDITE®

for on any of these metals Iridite gives you a high performance finish at a low cost from a simple chemical dip.

IF YOU WANT HIGH CORROSION RESISTANCE, you'll find an Iridite that will meet any military or civilian specifications for chromate finishing.

IF PAINT ADHERENCE IS IMPORTANT, you'll find Iridite prevents underfilm corrosion and soap formation.

OR, FOR BRIGHT, DECORATIVE FINISHES—

investigate zinc plate and Iridite (Bright) for a chrome-like decorative finish with more corrosion protection than conventional chrome plating . . . or Iridite (Metcote) as a treatment for copper that eliminates the need for buffing in the copper-chrome system; produces a sparkling bright finish!

Write for literature and send us samples for test processing. See "Plating Supplies" in your classified telephone directory or write direct.

Iridite is approved under government specifications.

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Manufacturers of Iridite Finishes for Corrosion Protection and Paint Systems on Non-Ferrous Metals; ARP Plating Brighteners.

Personals

supervised specifications work on aluminum and acted as a technical advisor to the Kaiser development and engineering department. Previously, he was with Reynolds Co. For 12 years before the war, Lawless was associated with various naval aviation experimental stations, where he was concerned with aircraft specifications, engineering and material research and standardization.

Ray N. Griffin has been named Vice-President in charge of Sales and Advertising for Bart Messing Corporation and associated companies, Bart Manufacturing Corp., Sel-Rex Precious Metals, Inc., Bart Laboratories Co., and Bart Products, Inc. Griffin was formerly Treasurer of the organization.

Griffin Hopkins

Prior to joining these corporations, 15 months ago, the newly named officer was administrative head of accounting and auditing at the Kansas City office of the Atomic Energy Commission. During World War II, he was Chief Administrative Assistant for the U. S. Army New York Office for the Manhattan Project.

A native of Texas, Griffin studied Business Administration at Texas Christian University. He was employed also for several years by the Corps of U. S. Army Engineers in various administrative capacities.

Announced at the same time was the appointment of **William A. Hopkins** as Vice-President in charge of manufacturing of the Bart Companies.

Closely associated with the electroplating industry since 1934, Hopkins studied metallurgical engineering at the University of Cincinnati. He was employed as a plating engineer in various divisions of the Electric Auto-Lite Company until 1945, when he joined Continental Die Casting Corp. as plant manager. He was also associated with Gerity-Michigan Corp. as technical director, and prior to his joining the Bart-Messing organization about one year ago was Detroit area sales manager for McGean Chemical Co. During World War II, Hopkins was associated with Kellex Corp. in work on the Manhattan project.

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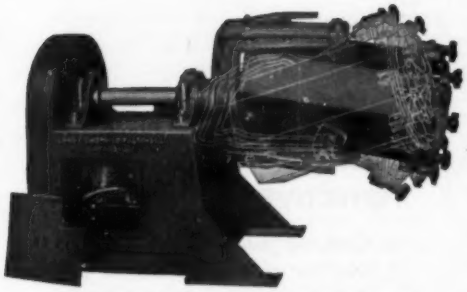
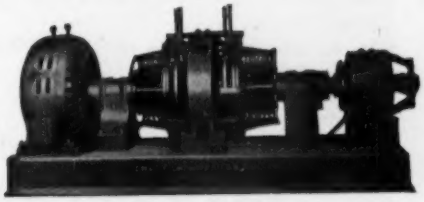
ECONOMY : EFFICIENCY : DEPENDABILITY

LET US SUPPLY YOUR NEEDS FOR YOUR PLATING OR POLISHING DEPARTMENT

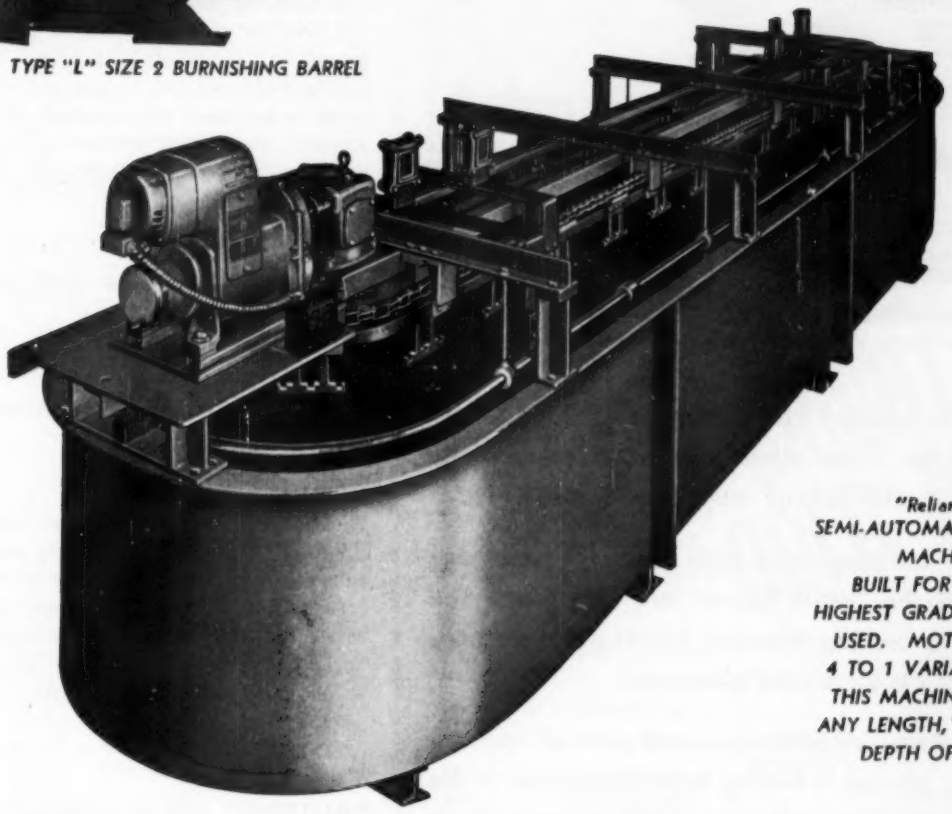
WRITE FOR FURTHER DETAILS



TYPE "L" SIZE 2 BURNISHING BARREL



3000 AMP. 6 VOLT GENERATOR SET



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SEMI-AUTOMATIC PLATING MACHINE
BUILT FOR SERVICE
HIGHEST GRADE MATERIAL USED. MOTOR ½ HP
4 TO 1 VARIABLE SPEED.
THIS MACHINE IS BUILT ANY LENGTH, WIDTH AND DEPTH OF TANK.

Chas. F. L'Hommedieu & Sons Co.

MANUFACTURERS of

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FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A 1126.

The PROTECTION of ALUMINUM

Drawing courtesy of Piasecki Helicopter Corporation, Morton, Pennsylvania

THE H-21 Piasecki Tandem Helicopter—the "Work Horse"—is ideally suited for rescue work in areas inaccessible by other means, and in all kinds of rough weather.

For durable paint adhesion and high corrosion-resistance aluminum parts of the "Work Horse" are Alodized. The "Alodine" protective coating chemical bonds paint, extends paint life, and protects unpainted aluminum.

Because of its economy, effectiveness, and ease of application, the Alodizing process is finding wide-spread use in the aircraft field and in other industries fabricating products of aluminum.

Alodized aluminum meets the requirements of Military Specification MIL-C-5541. Write or call for coating and process data on "Alodine".

"Alodine" Trade Mark Reg. U. S. Pat. Off.

CHEMICALS ACP PROCESSES

AMERICAN CHEMICAL PAINT COMPANY

General Offices:

AMBLER, PENNSYLVANIA

Detroit, Mich. ***Niles, Calif.*** ***Windsor, Ont.***

"ALODINE" PROTECTS BOTH PAINTED AND UNPAINTED ALUMINUM

"Alodine" forms an amorphous non-metallic surface on aluminum which is thin, tough, durable, continuous with and a part of the basis metal. The "Alodine" film (or skin) anchors paint, prolongs paint life, and protects aluminum exposed unpainted to the atmosphere.

ALODIZING IS EASY AND EFFECTIVE

The Alodizing process is a chemical one and does not require electrolytic techniques or equipment. Alodizing is simple, fool-proof, low in cost, and requires a minimum of equipment. Essentially, the process consists of the following easily controlled operations or steps:

1. Cleaning the work.
2. Rinsing the cleaned aluminum surfaces.
3. Coating with "Alodine."
4. Rinsing with clean water.
5. Rinsing with warm "Deoxylyte" (acidulated rinse).
6. Drying.

AFTER TREATMENTS: Alodized aluminum provides an ideal bonding surface for paint, wax, adhesive, or other organic finishes. These should be applied in accordance with the manufacturer's directions. Unpainted or exposed areas will be protected by the tough, durable "Alodine" skin.

"ALODINE" MEETS SERVICE SPECIFICATIONS

"Alodine" applied by immersion or spray complies with the rigid performance requirements of both industrial and Government specifications. The following is a list of Service Specifications which "Alodine" meets.

MIL-C-5541	U.S. Navord O.S. 675
MIL-S-5002	16E4 (SHIPS)
AN-E-19	AN-C-170 (See MIL-C-5541)
AN-F-20	U.S.A. 72-53 (See AN-F-20)

Personals

O. K. Irgens has been named development and service chemist in the cleaner department of Hanson-Van Winkle-Munning Company, Matawan, N. J.

Irgens

Irgens joins H-VW-M from Nopco Chemical Company where he was technical service and development chemist in the company's metal-working division. He formerly worked with Esselen Research Corporation for 5 years, and Remington Arms Company as chief chemist of the Lake City Ordnance Plant.

He is a graduate of North Carolina State, B. S. in chemistry, 1935.

Henry J. Noebels has been named to head the Applications Engineering Division of Beckman Instruments, Inc.

Noebels

Noebels has been associated for the past eight years with the Heyden Chemical Company, Garfield, N. J., in charge of the physical instrumental analytical research laboratory. He worked also during this period as Adjunct-Professor of Analytical Instrumentation at the Newark, N. J. College of Engineering.

A Rutgers' graduate in research chemistry, Noebels worked for the U. S. Army Ordnance Department in fuels and lubricants from 1941–1944.

J. R. Johnstone has been designated manager, Carbon Products Sales Department, by National Carbon Company, a division of Union Carbide and Carbon Corporation. Johnstone graduated from the University of Illinois in 1933 with a B.S. degree in Electrical Engineering and has been with National Carbon Company since 1937.

His duties in the new position include the sale of carbon and graphite brushes for motors and generators, and carbon and graphite chemical and mechanical specialty products.

The appointment of **C. E. Ford** as manager, Chemical Carbon Sales Department, was also announced. Ford graduated from Purdue University with a B.S. degree in Chemical Engineering and later received an M.S. degree from Harvard University. He then spent some time with a consulting engineering firm before joining National Carbon Company in 1937.

Among Ford's newly assigned activities will be the sale of graphite anodes used in the chlorine-alkali industries and carbon and graphite equipment for the chemical and process industries.

William J. Hennessy, Sales Supervisor, has been given responsibility for sales to the steel industry of all products of the Metal Processing Department of the Pennsylvania Salt Manufacturing Company.

Under Hennessy's supervision will be sales of all alkaline cleaners, emulsion cleaners and phosphate coating and lubricating products now sold to the steel industry. Formerly district sales manager for these products in Pittsburgh, he is widely known in the metal finishing field.

John M. Davidson, formerly Philadelphia district sales manager for Industrial Chemicals, has been assigned to the Metal Processing Department as Sales Supervisor for all other sales of the department except phosphate coatings and lubricants.

Davidson will supervise sales of metal cleaners and other specialties to the nonferrous industries and all metal fabricators. He also gained considerable experience in this field as a technical sales service

Produces mirror-like deposits regardless of thickness ..... without scratch brushing or buffing.

the revolutionary Sel-Rex®

BRIGHT GOLD PROCESS

Hundreds of firms tested SEL-REX Bright Gold Process and all enthusiastically adopted it as their new gold plating standard. There are many reasons . . . here are a few:

- Excellent "throwing power" and metal distribution.
- Produces fine grain deposits, double the hardness of conventional gold.
- Eliminates the need for scratch brushing or buffing.
- Ideal for specification plating.
- Operates at room temperature.
- No complicated equipment required. Conventional racking may be used.
- Solution is stable and easily maintained.

Packaged in 1, 5 and 10 ounce bottles.

SAVE *time and money...* investigate the new Sel-Rex Bright Gold Process!

MAIL COUPON TODAY!

Sel-Rex Precious Metals, Inc., Dept. PL-10
229 Main Street, Belleville 9, N. J.

- ☐ Send trial order of 1-ounce of Sel-Rex Bright Gold Salts.
- ☐ Mail complete literature and prices.
- ☐ Mail information on SEL-REX Silver Sol-U-Salt, Gold and Rhodium.

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whatever the job . . .

Whatever you need in a heat exchanger is available in a standard design INDUSTRIAL unit tailored to your requirements. Depending on the solution, the tubes for the solution are made of steel, copper, pure nickel, stainless steel, other alloys, or impervious graphite. Heat transfer area of any amount is obtained by the combination of any number of tubes. Space and location requirements are met with floor stand or with ceiling or wall mountings. Whatever the job, INDUSTRIAL offers the heat exchanger ideally suited to the particular conditions.

And you get these built-in advantages. The INDUSTRIAL heat exchanger does double duty in that the same unit is used for both heating and cooling. Either manual or automatic temperature controls can be used. Insulated shells add to the efficiency of the unit. Provisions for easy cleaning and inspection of the tubes assure lower maintenance costs.

INDUSTRIAL heat exchangers are available with or without suitable motor-driven pumping unit on base.

Full particulars and recommendations for any job will be given upon request

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INDUSTRIAL
FILTER & PUMP MFG. CO.
5914 Ogden Avenue, Chicago 50, Illinois

PRESSURE FILTERS
DEMINERALIZERS
RUBBER LININGS
CORROSION TEST CABINETS
HEAT EXCHANGERS

Personals

representative in the Pittsburgh area before coming to the Philadelphia district sales offices.

Clifford A. Hampel, chemical engineering consultant, of Homewood, Ill., has been elected president of the Chicago Technical Council, a federation of scientific, engineering, and technological societies.

Hampel

Hampel succeeds **Dr. Chris E. Barthel, Jr.,** Chicago, now Resident Director, State and Industrial Research Institute, Rangoon, Burma.

Hampel is editor-in-chief of the Encyclopedia of Chemical Reactions and is currently engaged in editing a forthcoming Handbook of Rare Metals.

Roman C. Bender has rejoined the metal finishing equipment and supplies sales staff of Frederic B. Stevens, Incorporated. He will cover the state of Indiana and operate from the Stevens Indianapolis Branch at 36 Shelby Street.

Bender's combined experience, in both the polishing and plating lines, totals over 20 years. Five years of this experience was gained while serving as a Stevens representative immediately following World War II.

He is an active member of the Indianapolis Branch, American Electroplater's Society.

Charles P. Egolf, III, has been appointed sales and service representative for the state of Florida by the Diamond Alkali Company. He succeeds **Frank V. Allen,** who now is associated with the Riverside Laundry of Miami. Egolf, whose home is in Lakeland, will handle the complete line of Diamond's numerous chemicals. For the past year he has been employed as a research chemist by the Food Machinery & Chemical Corp. at Lakeland. Prior to that time, he was a research chemist with the International Minerals & Chemical Corp. at Mulberry.

A native of Pennsylvania, Egolf graduated with a B.S. degree in chemistry from West Virginia Wesleyan College and then took courses in the Graduate School of Chemistry at Florida State University.

one glance proves there's no equal to H-VW-M Bias Sisalweev

See that weave? The sisal is cut *on the bias.* Every fiber is directed *toward* the cutting edge. There's no danger of whole strands flying off at high speed. Every Bias Sisalweev wears *evenly* and outlasts any other design.

You'll find a Bias Sisalweev ideal for heavy cutting down of drawn, stamped, or cast ferrous and non-ferrous articles. You can use it at high or low speeds—it's impossible to scorch at any speed or pressure. And, it's ventilated —24 air channels give extra cooling.

Bias Sisalweev is supplied either treated or untreated, but we recommend the exclusive H-VW-M HC, (heavy cut) treatment. This not only increases the rate of cut, but lengthens wear life and power to hold composition. And for buffing steel, you can't beat the combination of a Bias Sisalweev and H-VW-M 6-B-97 composition for heavy cut or 6-B-66 for medium cut with finer finish.

Bias Sisalweev is just one of many results of over eighty years of constant electro-plating and polishing development — a continuing policy summed up in H-VW-M Platemanship . . . your working guarantee of the best that industry has to offer not only in brushes and buffs—but in every phase of plating and polishing.

PLATEMANSHIP

PLATEMANSHIP

PLATING & POLISHING PROCESSES • EQUIPMENT • SUPPLIES

Further information on Bias Sisalweev is available on request.

Your H-VW-M combination — of the most modern testing and development laboratory — of over 80 years experience in every phase of plating and polishing — of a complete equipment, process and supply line for every need.

HANSON-VAN WINKLE-MUNNING CO., MATAWAN, N. J

PLANTS AT: MATAWAN, N. J. • ANDERSON, INDIANA
SALES OFFICES: ANDERSON • BALTIMORE • BOSTON CHICAGO • CLEVELAND • DAYTON • DETROIT • GRAND RAPIDS • LOS ANGELES • LOUISVILLE • MATAWAN MILWAUKEE • NEW YORK • PHILADELPHIA • PITTSBURGH ROCHESTER • SPRINGFIELD (MASS.) • STRATFORD (CONN.) UTICA • WALLINGFORD (CONN.)

H-VW-M

INDUSTRY'S WORKSHOP FOR THE FINEST IN PLATING AND POLISHING PROCESSES • EQUIPMENT • SUPPLIES

Personals

I. Melville Stein was elected president of Leeds & Northrup Company recently. Stein, formerly executive vice-president, succeeds **Charles S. Redding** who, after 14 years as Leeds & Northrup president, becomes chairman of the board, a post which has been vacant since the death of **Morris E. Leeds** in 1952.

Other changes in management responsibilities also were announced. **D. H. Schultz,** who has been secretary and treasurer since 1940, succeeds Stein as executive vice-president while retaining the duties of treasurer. **George W. Tall, Jr.,** vice-president, assumes the additional post as secretary.

Stein joined Leeds & Northrup as a salesman in 1919, was appointed director of research in 1928, elected a vice-president in 1944, and in 1951 became executive vice-president.

Charles S. Redding, new chairman of the board, virtually grew up with Leeds & Northrup. He was first employed by Morris E. Leeds as a draftsman in 1901, when the company was only two years old, but left fifteen months later to enter the University of Pennsylvania, where he was graduated in 1907. He rejoined Leeds & Northrup in 1909 as a salesman after teaching two years at the university, which honored him with a degree of Doctor of Science in 1947.

He was appointed associate sales manager in 1917 and successively became second vice-president, assistant treasurer, treasurer, factory manager and vice-president in charge of engineering and development, and president.

Richard F. Puffer was named assistant general sales manager; **Allen W. Rockwell** has been made manager of the Waterbury Branch; and **Robert R. Vance** will succeed Rockwell as works manager of the Waterbury branch of the American Brass Company.

Puffer, who is currently assistant manager of the Waterbury branch, graduated in 1930 from Princeton University and joined the company in 1934.

Rockwell came to the company as an employee in the tube mill in 1935. In 1939 he was appointed labor supervisor of the Waterbury branch, and was made works manager in 1946.

Vance graduated from Northeastern University in 1932, and became an employee of the company in 1937. In 1943 he was made economy supervisor of the Waterbury branch.

W. L. Pinner has been appointed Manager of the Process Development Division of Houdaille-Hershey Corporation.

Pinner

He will head up a unit of the Corporation which coordinates technical control of its manufacturing operations with process development in metallurgical, electrochemical, painting and other fabrication activities.

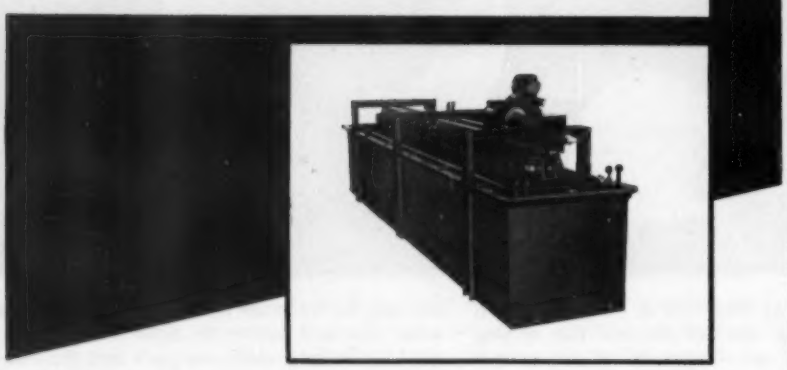
An employee of Houdaille-Hershey since 1923, Pinner is a University of Michigan chemical engineering graduate. He is widely known in the metal finishing field, having served as President of the American Electroplaters' Society. He is the first American to be elected to Honorary Membership in the Institute of Metal Finishing of England.

Also announced was the appointment of **William J. Pierce** as Supervisor of Process Development, in direct charge of research and development activities in this division. Pierce, who holds a chemical engineering degree, has served the company since 1937 and has also specialized in process involving metal fabrication and finishing.

F. B. O'Mara has been appointed Manager, Metallurgical Carbon Sales by National Carbon Company, a Division of Union Carbide and Carbon Corporation.

O'Mara graduated from Purdue University in 1936 and immediately became associated with National Carbon Company. He has had various administrative assignments in the industrial sales department, leading to his present appointment.

MANHATTAN RUBBER LININGS



. . . For Better Protection

Plating and pickling equipment manufacturers specify Manhattan Rubber Linings where ordinary applications do not afford adequate tank and solution protection against contamination and corrosion. Proof of the dependability and long life of Manhattan Rubber Linings is their record of giving continual, uninterrupted service for as long as 25 years or more.

Made from calendered sheets in required thickness of natural or synthetic rubber, Manhattan Linings eliminate plating "risks" . . . give longer life and more protection . . . eliminate stray currents. Every lined tank is tested to 15,000 volts to detect imperfections.

As a result of over half a century of experience in meeting the needs of equipment manufacturers, Manhattan has developed the most dependable and economical rubber linings with an exclusive rubber-to-metal bond that is inseparable.

For linings which meet your most exact requirements of economy and dependability, specify "Manhattan Rubber Linings."

RUBBER LINING PLANTS AT PASSAIC, N. J. AND NORTH CHARLESTON, S. C.

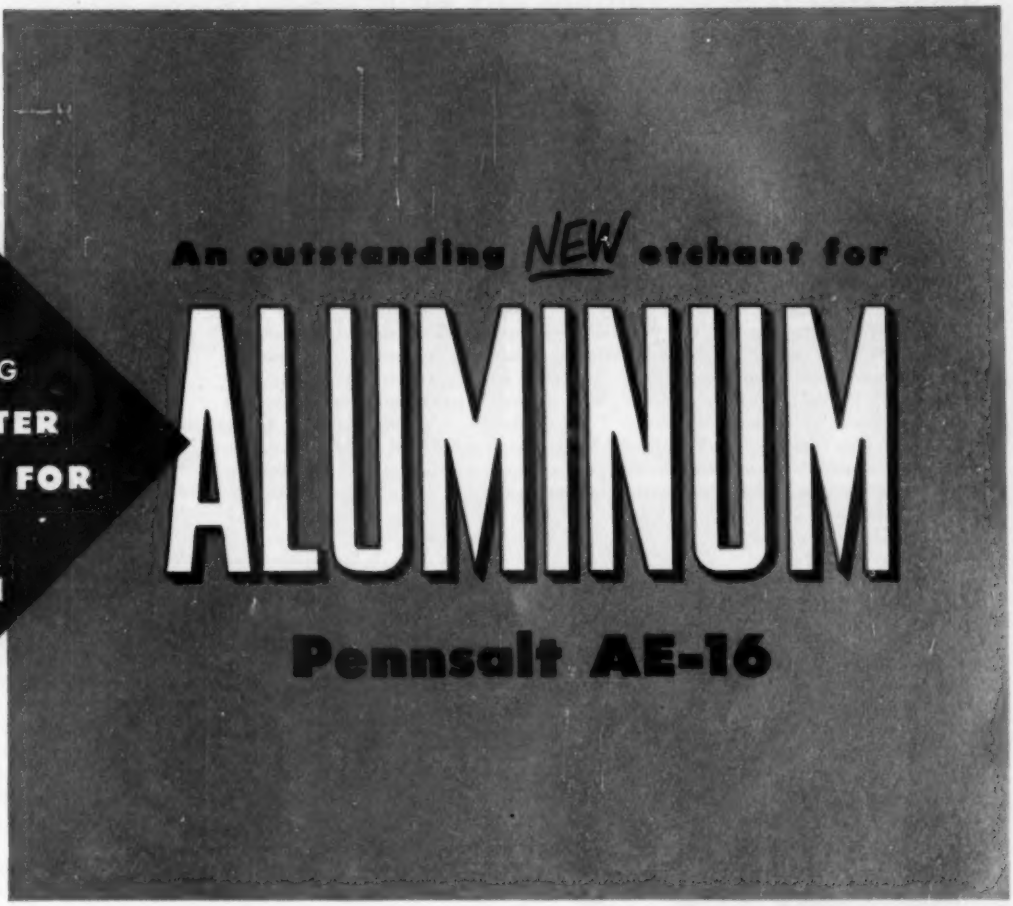
RM

MANHATTAN RUBBER DIVISION—PASSAIC, NEW JERSEY

RAYBESTOS-MANHATTAN, INC.

Manufacturers of Mechanical Rubber Products • Rubber Covered Equipment • Radiator Hose Fan Belts • Brake Linings & Blocks • Clutch Facings • Packings • Asbestos Textiles • Teflon Products • Powdered Metal Products • Abrasive & Diamond Wheels • Bowling Balls

MORE ON GETTING **A BETTER START FOR YOUR FINISH**



non-sludging • non-scaling • long-lived • time-saving • money-saving

Good news for fabricators! With Pennsalt's great new etchant—AE-16—you can give aluminum a beautiful satin finish *without* experiencing the usual headaches of sludge and scale—and at considerable lower cost than with *any* equivalent product!

Here's a case in point: A leading aluminum fabricator ran a side-by-side production test with AE-16 and an old-style etchant. After *nine weeks*, the original tankful of AE-16 had formed no sludge, was still performing satisfactorily! The old-style etchant had to be dumped and recharged twice in the same period.

Of course, AE-16's non-scaling characteristic means reduced tank maintenance costs, also. The AE-16 tank was cleaned by merely flushing it down with a hose—no chipping, no shoveling of rock-like scale.

AE-16 is a *quality* etchant In from one-half to ten minutes at normal tank temperatures, it produces a smooth, even, satin surface that easily conceals die marks and surface flaws. Few additions are required to keep up its working strength, and you'll find Pennsalt's method for determining the concentration exceptionally easy to follow.

All this means less down time, trouble-free operation, lower maintenance costs, increased production. Yet, even with its many advantages, *AE-16 actually costs less* than any comparable product on the market!

AE-16 is part of a complete aluminum preparation "package" Pennsalt now offers to fabricators. To help you use these excellent materials with maximum efficiency, Pennsalt also offers a Metal Processing Service, staffed by specialists in this field.

Further information—on AE-16 or on any of the other products in the Pennsalt "package"—is yours for the writing. Address: Metal Processing Service, Pennsylvania Salt Manufacturing Company, *East:* 286 Widener Building, Philadelphia 7, Pa. *West:* 2168 Shattuck Ave., Berkeley 4, Calif.

The Pennsalt Aluminum "Package"

Pennsalt Cleaner A-27: A new all-purpose non-etching cleaner that thoroughly removes all tough soils, including red and black marking inks. Rinses quickly and completely, even when allowed to dry on the work. Will not streak or stain.

Pennsalt Aldox*: A new powdered, acid-type desmutter and deoxidizer. Replaces nitric acid, does away with carboys and fumes.

Pennsalt Cleaner #85: An alkaline cleaner and deoxidizing agent recommended when aluminum is coated with a heavy layer of oil.

Pennsalt Cleaner MC-1®: An unusually economical general-purpose deoxidizing-type cleaner.

Pennsalt Cleaner EC-51*: A non-staining, organic-type emulsion cleaner.

Pennsalt Cleaner EC-54*: An emulsion cleaner which will not boil off, evaporate, or flash at use temperatures.

*Trade Name of PSM Co.

Pennsalt Chemicals

Trade Literature

L—1000. Meters for Corrosive Services—Now available is a new 14-page catalog picturing and describing porcelain, glass, and metal Flowrator fluid flow rate meters employing the variable area principle as designed and used for corrosive services. The catalog includes descriptions of porcelain meters and control valves, porcelain meters with metal armoring for shock resistance, hard lead meters with Hastelloy "C" floats for sulfuric acid solutions, rubber-lined meters for use in rubber-lined pipe systems, and various types of glass meters. Capacities and dimensions for the several types of meters are listed. Copies may be obtained by writing to Fischer & Porter Company, 830P Jacksonville Rd., Hatboro, Pa., or by using Reader Service Card.

L—1001. Pocket pH Meter—A revolutionary pocket-size *p*H meter and companion probe unit, now available for the first time, permit instant, on-the-spot *p*H determinations anywhere. The unit is described in a bulletin issued by Analytical Measurements, Inc., 585 Main St., Chatham, N. J.

Completely self-contained with batteries, in a Bakelite case 3 x 5⅞ inches x 2½ inches, this instrument is furnished, camera fashion, in an every-ready case with novel plastic tubes of buffer and KCl solutions. Total weight is 3 lbs. Both water-proof and fungus-proof, the every-ready case comes with combination hand-and-shoulder strap, allowing the instrument to be slung over the shoulder or hung around the neck leaving both hands free. For your copy of this descriptive bulletin, use Reader Service Card.

L—1002. Motor and Generator Bulletin—The Louis Allis Co., Milwaukee 7, Wisc., has recently prepared and released a new 16-page bulletin covering its line of d-c motors, ½ to 300 horsepower, and d-c generators, ¾ to 250 kilowatts. The bulletin is fully illustrated and photographs and cutaway drawings show details of mechanical construction, available motor enclosures for different operating conditions, motor applications, and several special designs.

Text and diagrams also give an unusually thorough and easy-to-understand description of electrical characteristics and show the features, advantages, and application of shunt, series, and compound motors. Motor-starting information is included, as well as a section on adjustable speed applications. Copies of this new bulletin may be obtained by using Reader Service Card.

L—1003. Vinyl Coatings Bulletin—The Gates Engineering Co., P. O. Box 1711, Wilmington, Del., have just released a new bulletin describing their line of performance proven protective coatings. Data are supplied on Gaco vinyl tank linings which are available in white or gray and are easily applied by brush or spray methods. Similar information is detailed on vinyl drum linings and other coatings designed for general fume and splash protection. For your copy of this descriptive bulletin, use Reader Service Card.

L—1004. Fact Sheet Bulletin—Octagon Process Inc., 15P Bank St., Staten Island 1, N. Y., have released a new bulletin describing an effective fingerprint remover oil.

The product, named Froil, removes fingerprints, prevents their formation and protects machined parts during operations. It is entirely non-toxic, pleasant to use, completely stable and non-corrosive. It is applied by a simple wipe-on, dip or spray method and is also an effective, rust preventive. Copies of this new bulletin are available. Use Reader Service Card.

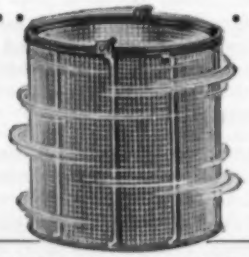
L—1005. Rotoblast Bulletin Revised—Pangborn Corporation of Hagerstown, Md., has revised its Blastmaster Rotoblast bulletin to include specification information on newly announced sizes of the Blastmaster airless cleaning barrel. The new 12-page 2-color bulletin now includes information on the 3 and 18 cubic feet Blastmaster barrels, as well as the originally announced 6 and 12 cubic feet capacity barrels. For your copy of this new bulletin, use Reader Service Card.

DRIES SMALL PARTS Faster-Better...

DOES IT FOR LESS!

Kreider Dryer with auxiliary gas heating unit (illustrated). Auxiliary steam heating unit available; also standard model without auxiliary heating.

Basket (shown below). Heavy gauge steel woven mesh over steel frame. Capacity, 1140 cu. ins.



Spin-Dries* up to 50 pounds in less than 2 minutes

Simple design . . . careful engineering, sturdy construction assure trouble-free, low-cost maintenance operation. Operates at 625 r.p.m. on less than 1 h.p.

No scarring or marring . . . with Kreider Dryer. Centrifugal force holds parts immovable in basket . . . assures smooth, evenly dried surfaces, long-lasting luster, minimum "rejects".

One man runs it! Standard model Kreider Dryer occupies less than 6 sq. ft. floor space. One man tends—loads, unloads—keeps production moving, prevents expensive, time-wasting tie-ups.

See for yourself! Write Dept. PL103 today for illustrated 4-page folder . . . also addresses of installations near you.

New Holland Machine Co., New Holland, Pa.

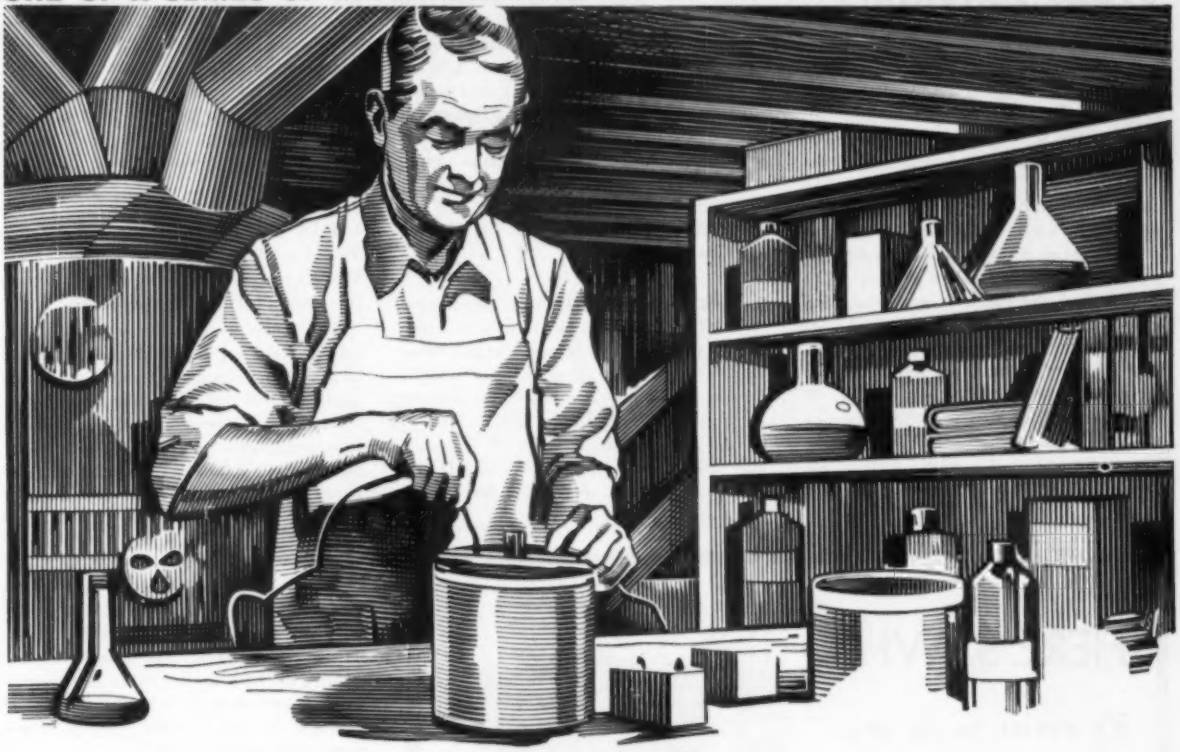
***Only 2 simple steps required . . .**

(1) Operator places wire mesh basketful of small parts in Dryer . . . turns motor "ON."

(2) Operator turns motor "OFF" . . . presses foot brake . . . removes basket.

NEW HOLLAND *KREIDER* DRYER

ONE OF A SERIES OF ADVERTISEMENTS ON THE HISTORY OF ELECTROPLATING



marvin udy's cadmium . . .
changed *your* way of life!

The modern Udylite Laboratory at Detroit, Michigan

A set of rusty piano wires is responsible for the fast, economical modern Cadmium Process you use today.

In 1919, young Marvin Udy became intrigued by a problem that had never been solved—how to rustproof piano wire without changing the tone. He knew that lead, copper and nickel had been tried without success.

After many experiments, Udy tried a little-known waste metal called Cadmium which he had recovered from flues of a western smelting company. After many failures, he finally succeeded in coating piano wire with the then unknown metal!

His new Cadmium Process worked . . . and an industry was born.

The infant Udylite Company, starting in a stockholder's basement, improved methods and techniques in applying the Cadmium. Through the years, the Udylite Corporation has continued to pioneer Cadmium. It developed the Ball Anode, Ball Anode Containers, the Brighteners . . . and has led every step of the way to the better rust prevention offered today in the newest Udylite Bry-Cad Process.

Udylite has shared these technical improvements with you and the entire industry . . . just as it has shared every improvement in Plating Equipment and Processes through the years.

This Udylite Cadmium Process is just *one* of *many* ways Udylite has pioneered in the electroplating field.

PIONEER OF A BETTER WAY IN PLATING...

THE Udylite CORPORATION
DETROIT 11, MICHIGAN

Trade Literature

L—1006. Electrolytic Stripper for Zinc Base Die Castings—Enthone, Inc., 442P Elm St., New Haven, Conn., has announced the development of a new liquid product for electrolytic stripping of defective copper, nickel and chromium plates from zinc base die castings. The product is called "Compound L-88" and is available as a ready to use liquid supplied in standard 13-gallon carboys. Defective zinc die castings are made the anode in the solution at 6 volts. Nickel and chromium coatings are stripped rapidly. Copper coatings are stripped readily but somewhat more slowly. When all of the defective plate has been removed and the zinc surface is exposed, a passive film is formed that inhibits further attack. Thus, die castings may be stripped to leave a surface that can be prepared readily for refinishing by a light buffing operation. The stripping solution is operated from room temperature to 180° F, and is stated to be extremely economical to use because there is no deterioration in the use of the stripper. The stripper has been in successful operation in industrial plants for over six months. Technical bulletin describing the product and its uses will be sent on request. Use Reader Service Card.

L—1007. Acid and Caustic Resistant Work Clothes—The most important feature in the newest catalog of acid and caustic resistant work clothes by Worklon, Inc., is the unbiased report by the Bureau of Ships of The United States Navy. This report indicates a life of "at least one year" for Orlon garments and Dynel garments against one week for cotton garments and slightly longer for those of wool. A ration of 50 to 1 . . . a tremendous potential savings in the cost of your industrial work clothes.

This completely illustrated book may be obtained by writing to Worklon, Inc., 253P W. 28th St., New York, N. Y., or by using Reader Service Card.

L—1008. Pamphlet on Surface Treating—A new pamphlet issued by Turco Products, Inc., 6135P S. Central Ave., Los Angeles 1, Calif., describes the complete line of Turcoating materials.

The bulletin includes a phosphating reference chart which outlines the purpose of phosphate coatings, government specifications met by Turcoating materials, recommended uses, methods of application, equipment required, metals which can be treated, coating weights in mg/sq ft and operation cycle. For your copy of this informative bulletin, use Reader Service Card.

L—1009. Furnace and Induction Brazing Bulletin—The story of how furnace and induction brazing reduces costs, increases production, and achieves higher quality is told in a picture-story case-history technique in a new bulletin announced by the General Electric Company, Schenectady 5, N. Y.

Designated as GEA 5889, the 12-page, two-color booklet is the latest in the Company's series on modern metal processing. It employs over 30 photographs to explain how various types of brazing have proven more economical than former processes. Examples include cases where furnace brazing has replaced casting, forging, machining, and welding of parts; and where induction brazing has replaced torch brazing, soldering, and riveting. For your copy of this valuable booklet use Reader Service Card.

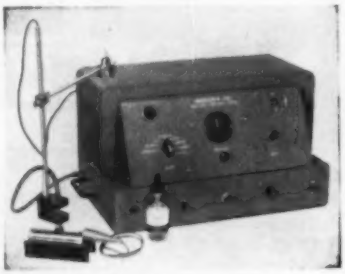
L—1010. Ion Exchanger Bulletin—To summarize the properties of most of their ion exchangers and indicate some of their uses, a 12-page bulletin (No. 2508) has been prepared by The Permutit Company, New York 36, N. Y.

The bulletin details a general history of ion exchange engineering, gives data on the proper selection of ion exchangers and lists general applications in the treatment of water and special problems associated with the recovery of valuable metals from solutions, separation of rare earths and treatment of wastes. For your copy of this bulletin, use Reader Service Card.

L—1011. Corrosion Resistance of Copper and Copper Alloys—For twenty-seven years, continuous laboratory research and field study of the nature of corrosive attack on copper and copper alloys have been conducted by The American Brass Company's technical staff. The

HERE'S WHY

it's easier to do your thickness testing with the



KOCOUR ELECTRONIC THICKNESS TESTER

1 Thickness testing is no longer a tedious, time consuming task. Tests require only about a minute to make.

2 Very simple to operate . . . no highly skilled technicians are required.

3 The instrument is virtually automatic . . . readings are direct . . . the human element does not affect the accuracy which ranges from 90–95%.

4 The minimum thickness which can accurately be determined is 5 millionths of an inch (5 ten-millionths of an inch for chromium.)

5 Requires no graphs, no charts, no standards or calculations.

6 Magnetic properties of either the base metal or the plating do not affect the test in any way.

7 Guaranteed satisfaction.

* Operation 105–125 Volts, 60 cycle A. C.

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4801 S. St. Louis Ave.
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• Pioneers & Specialists in Test Sets & Instruments for the electroplating industry since 1923.

Specify KOCOUR TEST SETS from your supplier.

your product deserves the *best*

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consider it *the best*

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McGEAN

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A 1136.

Trade Literature

results of this study have recently been brought up to date in a new 28-page booklet, "Corrosion Resistance of Copper and Copper Alloys". This publication, first of its kind in the industry, explains the chemical and physical nature of corrosive attack in its various forms.

Included is a tabulation indicating the relative corrosion resistance of the principal types of copper and copper base alloys when in contact with 183 different corroding agents. For your copy of this booklet use Reader Service Card.

L—1012. Technical Data Sheet—Nielco Laboratories, P. O. Box 4703, Detroit 19, Mich., have issued a new technical data sheet fully describing Ferr-O-Neil acid surface conditioners. These materials consist of a group of specially formulated acid compounds which differ in formulation and consequently cover a field of operation from that of pickling hot-rolled steel to electrolytic pickling of stainless steel.

Conditioners are produced from a phosphoric acid base, special surface active chemicals and selected wetting agents. There is no mineral acid present. They are made up and sold as a concentrate to be diluted with water when prepared for use. For your copy of this informative technical data sheet, use Reader Service Card.

L—1013. Simplified Acid Proofing of Concrete Floors—Concrete can be made corrosion proof against nearly all acid and alkaline splash and spillage by brush or trowel applications of a modified phenolic resin. Floors so badly corroded they permitted acid to seep through have been coated and protected for nearly two years, the coating showing neither attack nor wear in that time. The new material solves the long standing problem of protecting concrete in areas where investment in, or replacement by, acid proof brick is either too costly or time consuming.

This new product development is called Phenoline 300. Its application on concrete and similar surfaces is described in Bulletin A-50, published by the Carboline Company, 331P Thornton Ave., St. Louis 19, Mo. For your copy, use Reader Service Card.

L—1014. Folder on Portable pH Meters—A 4-page folder Bulletin 322—72 on Beckman portable *p*H meters—designed to simplify the choice of *p*H equipment—has been released by Beckman Instruments, Inc., South Pasadena, Calif.

Salient performance features and pictures distinguish the four *p*H meters in the series. They include a highly accurate instrument for laboratory and research studies; a line-operated model for routine measurements in the control laboratory, and two lightweight portables for plant and field applications. The booklet also lists typical industries where these instruments are used. For your copy, use Reader Service Card.

L—1015. Micro-Finishing Abrasive Belt—How tool cutting life and efficiency is extended when the cutting edge is micro-finished by the Behr-Manning method is portrayed graphically in a recent literature release of eight pages issued by Behr-Manning Corp., Troy, N. Y. The superior cutting edge is produced with abrasive belts. Magnified photographs prove the claims conclusively. Other advantages of the method are: lower finishing costs, lower capital investment, easy operation, and less edge fracture. For your copy of this descriptive folder use Reader Service Card.

L—1016. New Machine Washes Parts Automatically—Quick, automatic cleaning of small parts, complete assemblies and tools is made possible by a new air-powered washer now being produced by Kelite Products, Inc.

Cleaning is achieved by the action of an oscillating turntable which is sub-

THE NEW DANIELS 8H

Daniels presents the radically new 8H Plating Barrel with these innovations:

- New Cylinder Arm and Arm-lock
- New Materials and Modern Design
- New rubber-covered Contact Frame
- Three Cylinders to choose from — Bakelite, Rubber or high-temperature Lucite

Designed to fill the demand for a small barrel for efficient plating of small lots of bulk parts, the 8H is ideally suited for precious metal plating, laboratory work and as a supplement to the production plating plant.

DANIELS PLATING BARREL & SUPPLY CO.

MANUFACTURERS & DISTRIBUTORS
Electroplating and Polishing Equipment and Supplies

129 Oliver Street, Newark 5, N. J.
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Be sure to write today for our new illustrated catalogue

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UNICHROME
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News about
COATINGS for METALS
Metallic . . . . . Organic . . . . . Decorative . . . . . Protective

This Equipment Helps Cut Finishing Costs

A better finish ...and a saving, too

Plating golf club heads in the Unichrome SRHS Chromium Bath has made a distinct difference to one plant. There is less "burning" and therefore fewer rejects. The finish is brighter. Current consumption is less, which saves power costs. These results are due to the wider bright plate range and higher cathode efficiency of the SRHS Bath. Bulletin gives full facts.

PRACTICAL PAINTING FOR PLATING PLANTS

Painting with ordinary paints doesn't pay off in plating shops. Protecting with Ucilon* Coating Systems *does*. These coatings really withstand the chemical solutions and high humidity. At one plant, for instance, they have given more than 3 years' service on tanks, ducts and walls. Such coatings can obviously lengthen life of equipment, increase time between paint jobs, keep a plant looking better to encourage better work.

*Trade Mark

Insulations now made for temporary or long use

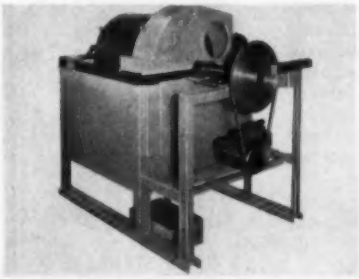
Platers can now practically choose a "custom" insulating material for the job on hand. Stopping off for plating, being a temporary application, is best handled by one of the Unichrome Stop-off Lacquers or Compounds. These are easy to apply, easy to remove once the work is plated. For permanent installations, on composite racks, conforming anodes and tank grids, solid Unichrome rods, tubing, and sheets offer the needed durability. For insulating working "tools," such as racks, Unichrome Coating 218X proves best. Specific data on each available.

UNITED CHROMIUM, INCORPORATED
100 East 42nd Street, New York 17, N. Y.
Detroit 20, Mich. • Waterbury 20, Conn.
Chicago 4, Ill. • Los Angeles 13, Calif.
In Canada:
United Chromium Limited, Toronto, Ont.

United Chromium applies 25-year working knowledge of plating to provide equipment for lower operating expenses

IMPROVED plating processes and coatings go a long way toward assuring the best possible finish at the lowest cost. However, equipment, too, affects results and profits. An inefficient or insufficient current supply gives trouble. Breakdowns in heating or cooling elements snarl production. Anode design affects costs and quality, too.

Realizing this, United Chromium has taken the next step in contributing to finishing department efficiency. Now, in addition to the widely used Unichrome Plating Processes and Unichrome Organic Coatings which supplement them, several specialized types of Unichrome equipment are being made available. Already in service in many plants, they are proving their ability to help reduce costs.



CHROMIUM PLATING 500,000 PARTS

The Unichrome Chromium Plating Barrel answers at last the problem of chromium plating small parts without prohibitive handling expense. It successfully plates whole batches at a time. Output soars wherever it's being used. At one plant, for example, 500,000 small parts were plated by *one* barrel, in *one* day, by *one* operator.

HEAT EXCHANGERS THAT SELDOM NEED EXCHANGING

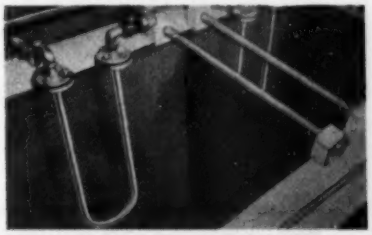
Unichrome Tantalum Heat Exchangers, the shell and tube type, have tantalum internal tubes. These tubes maintain heat transfer efficiency, lengthen equipment life in acid solutions, reduce maintenance to an absolute minimum. Result: Lower operating costs.

RECTIFIER WITH OVERLOAD CAPACITY

The line of Unichrome Selenium Rectifiers is complete . . . includes models to meet all plating and anodizing requirements. Self-contained units with built-in meters and controls, basic rectifiers with remote control, water-cooled models for extra protection against corrosion, saturable core reactors for stepless automatic regulation of current or voltage are all available. The Unichrome Extra Heavy Duty Selenium Rectifier carries the same guarantee as a motor generator set – to operate *continuously* at full load and at a 25% overload for two hours. All Unichrome Rectifiers provide full wave rectification with D.C. output that has less than 5% ripple.

ANODES WITH LONG ACTIVE LIFE

The right anodes for chromium plating are those designed to give good current distribution and no overheating; that provide good contact even on caked anode bars; that withstand the action of chromic acid baths during both idle and active periods. Unichrome tin-lead alloy anodes, designed with exactly these features, deliver unusual service.



HEAT COILS PAID FOR THEMSELVES

Made from acidproof metal, Unichrome Tantalum Heating Coils are working wonders in reducing maintenance costs. One plant installed 2 tantalum coils in their chromium plating tank, and took stock a year later. They found that the coils had already paid for themselves both in savings on usual repairs on former coils, and in production normally lost during the downtime. Every additional year of service—many of which are expected—will pay a bonus.

★ ★ ★

Bulletins with more information available – write or phone us.

Trade Literature

merged in a cleaning solution. Speed of the automatic parts washer may be varied from 0 to 240 oscillations per minute by dialing the desired speed on the ¼ horsepower air motor. The motor is operated by commonly available air pressures of from 30 to 120 psi.

A free bulletin illustrates and describes the machine in detail. Copies may be had by request to Kelite Products, Inc., 1250P North Main Street, Los Angeles 12, or through use of Reader Service Card.

L—1017. Catalog on Manually-Operated Indicators—Complete information about how manually operated portable and panel indicators are being used to measure precisely temperature, electrolytic conductivity or *p*H is contained in a new 24-page catalog, "L&N Manually-Operated Indicators for Temperature, Electrolytic Conductivity and *p*H Measurements", just published by Leeds & Northrup Co., 4907P Stenton Ave., Philadelphia 44, Pa. For your copy of this useful catalog use Reader Service Card.

L—1018. Bulletin on Steel Shot Abrasive—A new bulletin describing Wheelabrator Steel Shot, a new blast cleaning and peening abrasive, has been published by American Wheelabrator & Equipment Corp., 1180 S. Byrkit St., Mishawaka, Ind.

Of particular interest in this 8-page illustrated booklet is the discussion of the factors important to the economical and efficient consumption of steel shot abrasive; a photographic comparison of the useful lives of different abrasives; and a discussion on how to perform abrasive tests under actual operating conditions. Copies of the bulletin are free. Use Reader Service Card.

L—1019. Liquid Polymer-Epoxy Resin Combinations—Preliminary formulas and applications for liquid polymer-epoxy resin combinations, a new development in the potting, adhesive and coating fields, have been assembled in a portfolio by the Thiokol Chemical Corp., Trenton 7, N. J. Formulas and physical characteristics are given for combinations of Thiokol with such epoxy resins as Bakelite's BRR 18794, the Ciba Company's "Araldite", CN 503 and Shell Chemical's "Epon" 828. Compounded with these epoxy resins are Thiokol Liquid Polymers LP-3 and LP-33.

Physical characteristics contributed by Thiokol to these compounds have been determined by severe laboratory tests and, in several cases, use in actual service. These characteristics include permanent flexibility, impact resistance, low shrinkage, good wetting properties and low temperature performance. For your copy of this portfolio, use Reader Service Card.

L—1020. Flexible Plastic Coating—Stonhard Stoncote, a new protective coating to be used in all maintenance areas where rust and corrosion are special problems, is presented in a 4-page folder story. Stoncote resists acids, brines, ammonia and many other chemical agents. It provides tough, stable, non-oxidizing, acid and water-resistant film over metal, concrete or wood; being adapted especially for tanks, pipes, vats, ducts, floors, walls, equipment, machinery, structural steel and ceilings. For your copy of this folder, write Stonhard Company, 1306P Spring Garden St., Philadelphia 23, Pa., or use Reader Service Card.

L—1021. New Photomultiplier Attachment—A manyfold increase in the sensitivity of the Beckman Model B Spectrophotometer is provided by a new photomultiplier attachment announced by Beckman Instruments, Inc., South Pasadena 1, Calif.

Used in the 320 to 600 millimicron range, the attachment permits measurement of low light levels in transmission and reflectance work. In flame photometry, it allows the chemist to analyze traces of many elements routinely—not merely the sodium and potassium customarily associated with flame work. Further information on the new photomultiplier attachment can be obtained through use of Reader Service Card.

L—1022. Literature on Chemical Coatings—The advantages and uses of synthetic resin-base coatings in the chemical industry are described in a new 8-page illustrated folder published by Bakelite Co., a Division of Union Carbide and

All chemists wear white coats!

Unlikely and unimportant but even if they look alike there's an important difference between them. KLEM chemists have dealt with almost every conceivable problem in their field. Their extensive experience enables them to more readily comprehend plant situations than ordinary chemists. The KLEM laboratory, equipped with the finest technological equipment for duplicating exact plant conditions and procedures, enables them to determine the correct answer to tough problems.

Let us help eliminate your bottlenecks, assist you as we have others in establishing profitable production schedules.

Representatives in most industrial areas.

3 OF 20 STANDARD KLEM PRODUCTS

KLEM STRIPPER No. 73—Heavy duty hot stripper for paint and enamels, rinses easily, eliminates hand scrubbing.

WATER WASH COMPOUND No. 203—Stops corrosion, keeps lines clean, prevents adhesion of paint to water curtain. Excellent for recovery.

RUST-SOL No. 124—Concentrated phosphoric acid surface conditioner. Removes oil and rust. Provides slight etch to promote adhesion of paint. Meets USA 3-213, TAC-ES431 and MIL-C-10578.

KLEM PRODUCT of the MONTH

MINIT KOTE

Cleans, neutralizes, phosphatizes in 60 seconds. Frees metal surfaces from all traces of oil and dirt. Deposits light, uniform, phosphate coating for better adhesion of paint to ferrous metals and aluminum. Write for details.

KLEM Chemicals Inc.
14601 LANSON . . . DEARBORN, MICHIGAN

Faster Automatic Polishing, with fewer adjustments, are "Touch of Gold" advantages assured by ALUNDUM abrasive.

Give your polishing the cost-cutting

"TOUCH of GOLD"

...with ALUNDUM* abrasive on your set-up wheels

Here are two big advantages that Norton ALUNDUM abrasive bring to your polishing:

Uniformity Careful processing control of Norton ALUNDUM abrasive assures that grains are uniform in size, structure and chemical composition. No oversize grains to mar surfaces — no flats, slivers or undersized grains that loaf on the job. Instead, you get a full quota of tough, sharp, equal-sized grains that stand up under severest conditions — each one doing its share of fast-cutting, uniform polishing.

High Capillary Action Norton ALUNDUM abrasive is specially treated to raise its capillarity, so that each grain soaks up glue easily and thoroughly. As a result, each grain is held as firmly as its neighbor — giving a strong, long-lasting, top-performing polishing wheel.

In Your Automatic Polishing advantages like the above are particularly important. With each ALUNDUM grain doing an equal share of the work, and each one tightly fixed to the wheel, you can be sure of top-quality polishing with minimum adjusting. That's the product-improving, time-saving "TOUCH OF GOLD" that will build *your* profits on *every* polishing job, from roughing to finishing!

See Your Norton Distributor for quick delivery of ALUNDUM polishing abrasive in the types, sizes, and surface treatments you need. Or write to NORTON COMPANY, Worcester 6, Mass. Distributors in all principal cities, listed in your telephone directory yellow pages under "Grinding Wheels." *Export:* Norton Behr-Manning Overseas Incorporated, Worcester 6, Mass.

G-261

NORTON

ABRASIVES

Making better products... to make other products better

*Trade-Mark Reg. U. S. Pat. Off. and Foreign Countries

Trade Literature

Carbon Corp., 300 Madison Ave., New York 17, N. Y.

The brochure, "Bakelite and Vinylite Resin Coatings for the Chemical Industry", presents sixteen case histories of actual industrial coating applications. Those particular resin-base finishes exhibit excellent resistance to most acids, alkalies and other chemicals.

Specific applications of coatings based on Bakelite and Vinylite resins described in the folder include acid tanks, shipping containers, plating racks, and steel tubing. The pamphlet also contains a tabulation of the effects of various chemicals upon vinyl resin-base coatings. Copies of this folder may be obtained by using Reader Service Card.

L—1023. Finishes for Aluminum—The question and answer section in Reynolds Metals *Technical Advisor*, Number 22, covers such items as machining 63S aluminum, anodizing aluminum alloys, wet-blast chromium plating and extrusion mill finishes.

Section 4 in the series on "Finishes for Aluminum" in this issue is devoted to various types of mechanical finishes.

Copies of *Technical Advisor* will be sent without charge upon request to Reynolds Metals Co., 2500P S. Third St., Louisville 1, Ky., or by use of Reader Service Card.

L—1024. Hints on Metal Cutting—A new illustrated booklet, offered by Clemson Bros., Inc., Middletown, N. Y., tells how to cut metals properly with hand and power hack saws and with band saws.

The booklet recommends the types of hand hack saw blades for cutting 15 standard materials. It also gives the types of blades to use with 66 different band saws, and recommends the correct blades and cutting speeds for use with 24 ferrous metals, 21 non-ferrous metals and 12 plastics and non-metallics. For your copy of the booklet, use Reader Service Card.

L—1025. Booklet on Materials Handling Costs—A revised edition of the popular Yale publication, "The How Book of Cost-Cutting Materials Handling"—incorporating the latest methods for analyzing materials handling operations in plants and warehouses—is now available from Materials Handling Division, The Yale & Towne Manufacturing Company, Philadelphia 15, Pa.

The 28-page book was prepared with the help of Dr. V. S. Karabasz, Associate Professor of Industrial Management, Wharton School, University of Pennsylvania.

Four pages illustrate various skids and pallets available and show how they can be used most efficiently. Other pages illustrate and describe briefly the most popular Yale industrial power trucks, hand lift trucks and hand and electric hoists. For your copy of this informative booklet, use Reader Service Card.

L—1026. Tungsten Metallizing Coils—Tungsten components are among items described in a 4-page booklet issued by the Tungsten and Chemical Division, Sylvania Electric Products, Inc., Towanda, Pa. The components are stranded tungsten coils and filaments for vacuum metallizing such as are used in the aluminizing of picture tube screens. The booklet is available on request. Use Reader Service Card.

L—1027. Industrial Filtration Literature—A new 8-page brochure by the U. S. Hoffman Machinery Corp., presents graphically the essential features and applications of their ten basic types of industrial filtration equipment. These include disc, cartridge, and pressure type filters, flotation units, vacuum stills, magnetic separators, and oil conditioners. Purpose of the equipment is to reclaim and repurify oils, coolants, solvents and industrial waters by removing solids, solubles and volatile contaminants on a continuous automatic basis. Copies may be obtained by writing to the manufacturer, Industrial Filtration Division, 9 Thompson Rd., Syracuse 6, N. Y., or by using Reader Service Card.

L—1028. Abrasive Belt Splicer Literature—Description of the operation as well as the savings resulting from the use of the Econaway abrasive belt splicer, together with specifications and prices,

Modern Facilities

A bright, clean, efficient plant.

Controlled Quality

Every batch checked against rigid quality "specs".

Friendly Service

Whether the market is short or long.

EXTRA HIGH QUALITY 99.7+% PURE

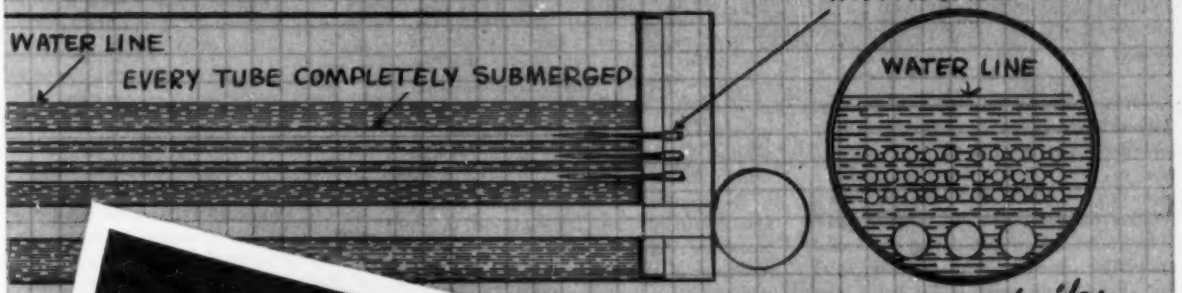
CHROMIC ACID

TECHNICAL GRADE—FLAKE

Ownership-management makes the difference. We think you will like the uniformly high quality of BFC Chromic Acid and the fair, friendly way we do business. Why not send us an order when you are again in the market?

BETTER FINISHES AND COATINGS, INC.
268 Doremus Avenue, Newark 5, N. J.
122 East 7th St., Los Angeles 14, Calif.

when you buy a steam boiler . . . be sure to look at the picture of a Sellers Immersion Boiler



There's no other boiler like a Sellers—

every square foot of heating surface is water backed— —100% effective!

The long, individually gas fired tubes in the Sellers Immersion Boiler are all completely submerged nearer the water level—and over the return tubes! Heat is therefore uniformly distributed through them—and directly into the water—no where else!

there's no scale problem!

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L—1030. Electronic Controls Booklet—"Cutting Production Costs with Electronic Controls"—a complete revision of the handbook that has become the "bible" of electronic control for thousands of engineers, production executives and management personnel is announced by Photoswitch, Inc., 77P Broadway, Cambridge 42, Mass.

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This is a unique development pioneered by Barco for providing an electrical insulating barrier in a pipe without interfering with its capacity or efficiency for conveying steam, water, chemicals, or gases. Besides promoting safety and preventing wasteful leakage of current, the joints are often useful in preventing pitting or corrosion due to electrolysis. For your copy of the descriptive bulletin use Reader Service Card.

L—1032. Industrial Bench Catalog—The Industrial Equipment & Bench Manufacturing Co., 98P South St., New Britain, Conn., has issued a new 1953 catalog describing their steel shop equipment. The catalog features many new items in laminated wood top benches, smooth top steel benches, pressed steel bench legs, steel bench drawers, all steel work stands, all steel machine stands, steel tote boxes, welding benches, bench parts and accessories. Construction, sizes, styles and other data are included. For your copy of this descriptive literature, use Reader Service Card.

L—1033. Precision Cleaning Wet-Blast Cabinet—A bulletin on the new Belmont wet-blast cabinet, used for precision cleaning and finishing has been issued by Vacu-Blast Company, Inc., P. O. Box 885P, Belmont, Calif. These wet-blast cabinets eliminate costly hand cleaning methods; they have no pumps—require little maintenance, have a more efficient blasting gun, provide good ventilation and lighting with a high level of illumination; cabinet design features a wide new window and a counter-balanced door for easy access. For your copy of this catalog sheet, use Reader Service Card.

L—1034. Bulletin on Dust Control—How dust can be controlled in metal-working industries is discussed in a bulletin published by American Wheelabrator & Equipment Corp., 1180 S. Byrkit St., Mishawaka, Ind. Particular attention in the bulletin is given to the use of high-efficiency cloth-tube-type dust collectors in the ventilation of grinding and annealing operations, sprue mills, and blast cleaning equipment. A section is also devoted to the role of cloth filtration in such hot operations as the collection of foundry cupola fumes. Copies of this illustrated folder may be obtained from the manufacturer or by use of Reader Service Card.

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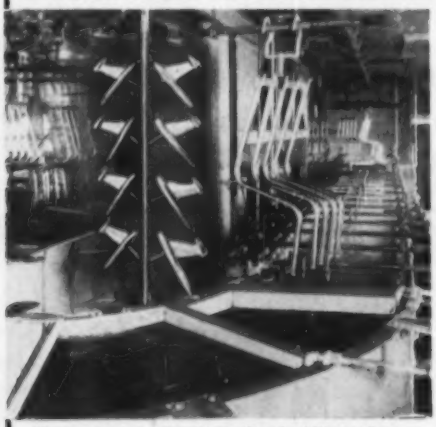

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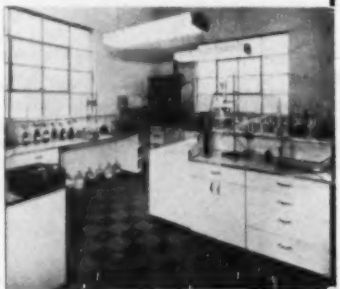

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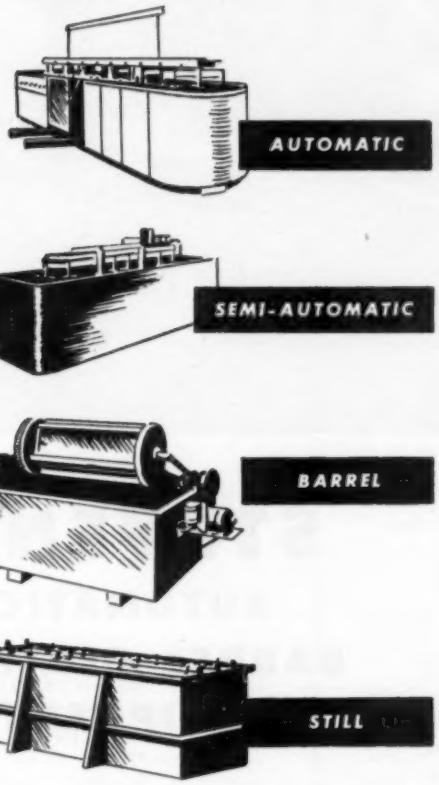

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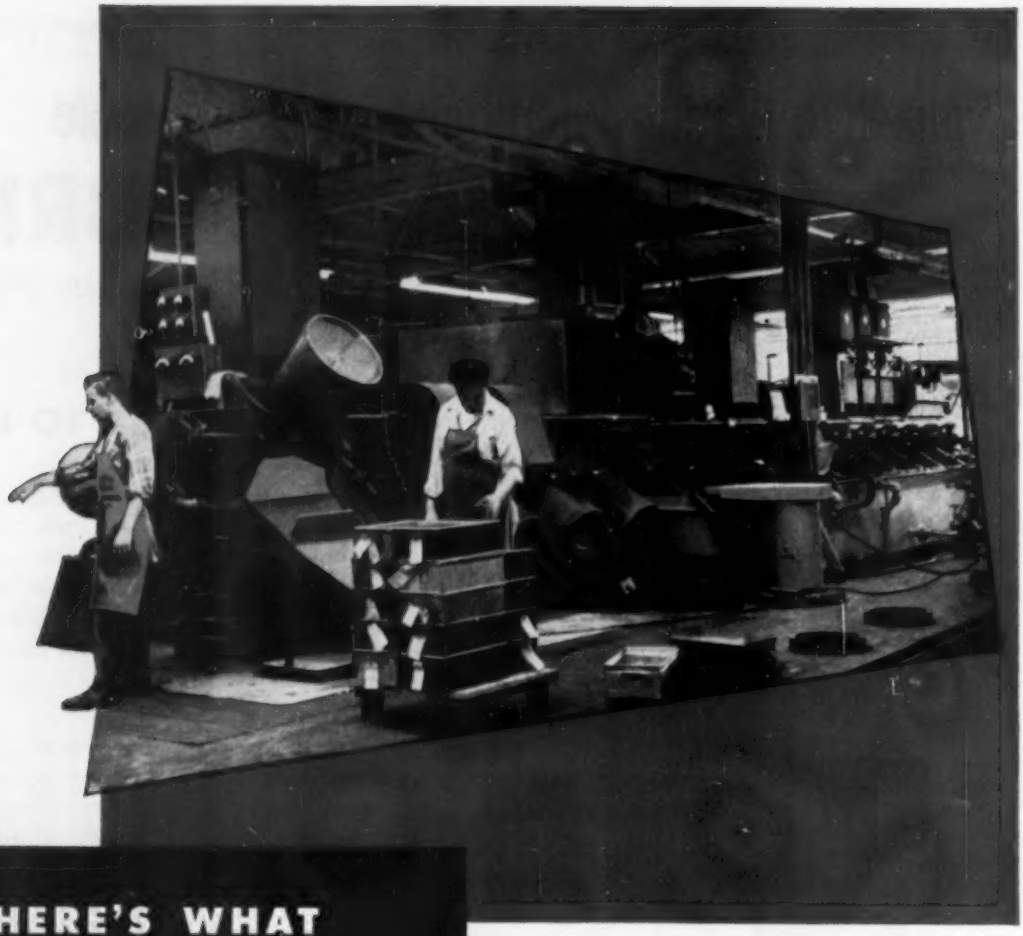

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This month's cover photo shows a specialized corrosion-resistant heavy-nickel plating operation on large steel drums at the Bart Manufacturing Corporation plant in Newark, N. J.

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Editorial

A. E. S. Executive Board "TUNES IN" . . .

FULLY AWARE of the importance of "tuning in" with its organization, the A. E. S. Executive Board this year has embarked on a program of increased mutual understanding.

The first step was taken on August 21. At that time the Board invited National Headquarters' staff to "tune in" on a full day's meeting which involved frank, open discussion about Headquarters' work and problems.

It is natural for people to appreciate being invited to "tune in" on facts about their organization and business, for proper "tuning in" prevents the reception of wrongly directed "broadcasts" of resentment which may be all too readily received in days of stress.

So impressed with the favorable results of this meeting and the spirit of the National Office staff, the Board proposed similar meetings from time to time.

Here was good public relations in action. This "tuning in" process proved one important thing to staff personnel participating: The Board was truly interested in them and their welfare. It proved, also, that the Board wanted to understand and to be understood.

Good public relations, like charity, starts at home. The healthy attitude of concern by the Executive Board augurs well for the future of the A. E. S. It marks the beginning of a new era of Society-wide public relations and increased understanding.

P. Peter Kovatis

EXECUTIVE SECRETARY, A. E. S.

DECOMPOSITION OF CYANIDES IN AQUEOUS SOLUTIONS*

W. R. MEYER†, R. F. MURACA‡ AND E. J. SERFASS§

Introduction

The decomposition of alkali cyanides in aqueous solutions is a problem to the electroplating industry. This decomposition requires that regular analyses be made to maintain dipping and plating solutions in good working order. It is the purpose of this paper to analyze the factors that lead to decomposition and to present data to evaluate quantitatively the magnitude of the cyanide loss.

How Cyanides Are Lost From Solution

Cyanides may be lost mechanically and chemically. Mechanical loss can be from dragout, spray and leaks. This type of loss will not be concerned with at this time other than to point out that mechanical losses can be exceptionally significant and may be greater than chemical losses. The surface tension of the solution will also affect the amount of loss, and lowering of surface tension to the order of 30 dynes per cm., may reduce dragout loss from 10 to 25 per cent. Spray losses can be reduced by adding surface active agents and by using floating pellets or balls.

Chemical loss of free cyanide may result by the following: (Ia) hydrolysis to form HCN, (Ib) hydrolysis to form ammonia, (II) oxidation to cyanate, (III) reaction with carbon dioxide, (IV) formation of complex ions and (V) oxidation to cyanogen.

Hydrolysis to Form HCN

Alkali cyanides are salts of strong bases and the weak acid hydrocyanic acid. Accordingly, they hydrolyze to yield an alkaline reaction (*p*H about 12) as follows:

Ia $$NaCN + HOH \rightleftharpoons NaOH + HCN$$

This reaction may also be written

$$CN^- + H_2O \rightleftharpoons HCN\ (aq.) + OH^-$$

The free energy change for this reaction at 25° C is, ΔF° = 6,575 cal./mole, from which the equilibrium constant can be calculated:

$$K = 3 \times 10^{-5}$$

If a gram-mole of sodium cyanide (49 g) is dissolved in one liter of water, it can be shown that the solution contains about 5.5×10^{-3} mole or about 0.15 gram of dissolved HCN. This accounts for the odor of HCN over a freshly prepared solution of alkali cyanide. However, this is a very weak concentration of HCN.

The removal of hydroxyl ions by the addition of any substance that yields a *p*H in solution below the equilibrium *p*H of hydrolysis Ia (about 12) will induce decomposition by disturbing the equilibrium indicated in reaction Ia. It is well known that the addition of acids will do this, but sometimes overlooked is the fact that slightly alkaline materials such as disodium hydrogen phosphate and sodium bicarbonate also can cause the decomposition of alkali cyanides.

In accordance with reaction Ia, the removal of HCN gas also will cause the decomposition of alkali cyanides. This loss of HCN gas might be made to come about by the aeration of a cyanide solution and, as is common in the electroplating industry, agitation of plating baths is carried out by streams of air. Unusually little HCN can be lost by air agitation since, as indicated in equation Ia, the removal of HCN increases the alkalinity of the residual solution and thus tends to repress the formation of HCN. In the laboratory, the bubbling of CO_2-free air through solutions of NaCN was actually shown to cause a negligible loss of cyanide.

If air containing carbon dioxide is passed through cyanide solutions, complete decomposition of cyanide will result in accordance with the following reaction:

Ib $$NaCN + H_2O + CO_2 \rightarrow NaHCO_3 + HCN.$$

Returning to equation Ia, it is seen that the above equation is merely a situation where the hydroxide ion formed in equation Ia is removed by causing it to react with carbonic acid; naturally, this results in the evolution of HCN. In fact, every electroplater is aware that the addition of any acid to alkali cyanide solutions will result in the evolution of HCN. In order to reduce the possibility of the decomposition of cyanides by carbonic acid, many plating bath formulations require the addition of NaOH so that the absorption of carbon

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*Presented at the Fortieth Annual Convention of the American Electroplaters' Society, June 16, 1953.
†President, Enthone, Inc., New Haven, Conn.
‡Assistant Professor, Department of Chemistry, Lehigh University.
§Head, Dept. of Chemistry, Lehigh University, Bethlehem, Pa.

TABLE I. ROOM TEMPERATURE DECOMPOSITION OF SODIUM CYANIDE SOLUTIONS

Solution	NaCN		NaCNO Formation g/l.	Total % loss of NaCN
	Start g/l.	After 9 days g/l.		
NaCN	116	96.2	5.4	17.0
	116	95.5	3.7	17.6
	116	85.3	8.0	26.5
NaCN-NaOH	116	115	0.8	0.8
	116	115	0.3	0.8
	116	112	3.1	3.4

dioxide from air occurs preferentially with the base instead of the cyanide:

Ic $2NaOH + CO_2 \rightarrow Na_2CO_3 + H_2O$.

Many electroplaters are plagued with the problems posed by the presence of excess carbonates in their plating baths. Many platers are not aware that the major source of carbonate in the plating bath is due to absorption of carbon dioxide from the air either at the surface of the bath or whenever air agitation is used. A reduction of contact area of the solution with atmospheric air will cause a corresponding reduction in the rate of formation of carbonate.

Perhaps it is proper at this point to indicate that the odor of HCN over a freshly prepared solution of alkali cyanide in part is due to the reaction indicated by equation Ia and in part to the reaction of the cyanide with atmospheric carbon dioxide indicated by equation Ic.

Although equation Ib shows $NaHCO_3$ as a product, this substance generally is not found in plating baths since NaOH reacts with it to form sodium carbonate:

Id $NaOH + NaHCO_3 = Na_2CO_3 + H_2O$.

Decomposition With Ammonia Formation

A type of hydrolysis occurs other than Ia. This is the hydrolysis to form ammonia and formate which can be written as follows:

IIa $NaCN + 2HOH \longrightarrow HCOONa + NH_3$

or

$$CN^- + 3H_2O \rightleftharpoons HCOO^- + NH_4^+ + OH^-$$

The standard free energy change and the equilibrium constant for the reaction are:

ΔF° *Data (25° C.)*

CN^-	39,140 cal./mole
H_2O	−56,560 cal./mole
NH_4^+	−18,960 cal./mole
OH^-	−37,585 cal./mole
$HCOO^-$	−82,891 cal./mole

$\Delta F^\circ = [-37{,}585 - 18{,}960 - 82{,}891] - [3(-56{,}560) + 39{,}140]$

$\Delta F^\circ = -8{,}896$ cal. per mole

$\Delta F^\circ = -RT \ln K = -1364 \log K$

$K = 3.6 \times 10^6$

The equilibrium constant indicates that cyanide can be decomposed completely by this hydrolysis and, in fact, it can. Any condition contributing to the loss of NH_3 should shift the equilibrium from left to right, corresponding to a more complete decomposition of cyanide. The act of raising the temperature, which tends to drive off ammonia, greatly accelerates the reaction by disturbing this equilibrium.

Although the equilibrium constant indicates that a complete decomposition of cyanide solutions can be achieved by reaction II-a, the activation energy seems to be quite high and so the reaction does not proceed very fast. In this, electroplaters are fortunate, otherwise a cyanide solution would not exist long enough for them to make use of it. It is possible that a catalyst exists which will accelerate this reaction. This catalyst would be quite useful for the destruction of waste cyanide solutions.

Rate of Decomposition

Thus far, one does not have any idea as to the rate of decomposition of cyanide solutions due to the hydrolysis reactions Ia and IIa, and the absorption of carbon dioxide as shown by equation Ib. A comparison in percentage loss of cyanide in a dilute solution of NaCN (5 g/l.) was made with a solution containing 5 g/l. of NaCN plus 40 g/l. of NaOH. After standing one week in uncovered beakers at 70° F., the sodium cyanide solution was decomposed over 90 per cent, whereas, the cyanide solution containing NaOH was decomposed less than 5 per cent. On the basis of these experiments, it is recommended that cyanide dipping solutions, particularly dilute solutions, should contain some free alkali to reduce decomposition. For example a solution containing 1-2 oz./gal. of NaCN should have at least 4 oz./gal. of NaOH present.

Experiments were carried out with strong solutions of NaCN to ascertain the effect of concentration. Solutions containing 120 g/l. (1 lb./gal.) of NaCN and 120 g/l. NaCN plus 120 g/l. of NaOH were allowed to stand in uncovered beakers at 70° F. for 9 days. The solutions were analyzed initially and at the end of 9 days for sodium cyanide and sodium cyanate. The results are shown in Table I.

It will be seen that a saving in decomposition loss of

TABLE II. DECOMPOSITION OF SODIUM CYANIDE SOLUTIONS AT 95° C.*

Time in Days	0	1	2	3	4	5	6
NaCN Solution	118	80	33	15	3	0.6	0.1
NaCN + NaOH Solution	118	92	50	34	19	4.0	1.4

*Results in g/l NaCN.

TABLE III. HIGH TEMPERATURE DECOMPOSITION OF CYANIDE SOLUTIONS*

Solution	Analysis	1 day	2 days	3 days	4 days	6 days	7 days
NaCN	CNO	3.0	1.4	0.9	0.0	0.0	0.0
	NH_3	18.2	12.6	3.2	0.9	0.0	0.0
NaCN + NaOH	CNO	4.6	1.8	1.3	1.0	0.0	0.0
	NH_3	19.5	17.6	8.0	4.2	0.5	0.0

*Values are in ml of base/100 ml of solution.

the order of 20 per cent results from the use of NaOH in a solution as strong as 1 lb./gal. of NaCN. Some cyanate formation occurs, but the loss from this reaction is small. (The formation of cyanate will be taken up later.)

The data already shown do not give any idea as to the rate of decomposition of cyanide solutions due to the two hydrolysis reactions Ia and IIa, and the carbon dioxide absorption reaction Ib. Solutions containing approximately 1 lb./gal. NaCN and 1 lb./gal. NaCN + 1 lb./gal. NaOH were heated in covered beakers about 95° C. Every 24 hours the solutions were analyzed for NaCN content.

Table II shows again that NaOH reduces decomposition of NaCN solutions even though the increased hydroxide concentration should increase the loss of ammonia (strong bases displace a weak base like ammonia) and thus should tend to cause a more rapid decomposition in accordance with reaction IIa. Since this is not the case, it may be conjectured that reaction IIa takes place via HCN:

$$HCN + 2H_2O \rightarrow NH_3 + HCOOH,$$

and that the concentration of HCN is decreased in accordance with equation Ia when the hydroxide ion concentration is high thus repressing the hydrolysis reaction.

Inspection of the data in Table II suggests that the hydrolysis of cyanides follows an exponential curve. The data were tested for a first order reaction rate by plotting the logarithm of the concentration against the time in days. As expected, the values did not fall exactly on a straight line since the decomposition does not proceed by a first order reaction but the best line was drawn through the data points. By determining the slope of this line, the reaction velocity constants were obtained for the decomposition rates of the solution shown in Table II. Then the half-life was calculated.

Results:	NaCN Solution	NaCN-NaOH Solution
k	= 0.89	0.42
$t_{½}$	= 0.78 days	1.7 days

It should be borne in mind that the one-half life calculated is valid only for the conditions of the test concerned. The half life will vary depending upon temperature, concentration of NaCN and concentration of NaOH.

The solutions used for obtaining the data in Table II also were analyzed for cyanate and ammonia during the 7 day period of operation. The analyses are only indicative of the fact that both cyanate and ammonia are formed at high temperatures and also that ammonia is lost by evolution from the water solution and that cyanate slowly decomposes. The hydrolysis of cyanate was not expected since it was presumed that the hydrolysis would not proceed appreciably in alkaline solution. However, further experiments showed that cyanates do hydrolyze slowly in alkaline solutions.

Oxidation of Cyanides to Cyanates

The oxidation of cyanides to form cyanates takes place readily in the fused state. Oxidation in aqueous solutions may be carried out by strong oxidizing agents, such as hydrogen peroxide, permanganates or iodates. The half-cell reaction is:

III-a $2OH^- + CN^- = CNO^- + H_2O + 2e$ $E^\circ = 0.96$ volt.

TABLE IV. ELECTROLYTIC DECOMPOSITION OF SODIUM CYANIDE SOLUTIONS

Solution	Current Density Amp./Sq. ft.	After Electrolysis		Per cent Total Cyanide Loss
		Cyanide g/l.	Cyanate g/l.	
NaCN—120 g/l.	5	113	4.4	5.8
	10	112	5.6	6.7
	50	99	11.5	17.5
	100	93	22.0	22.5
NaCN—120 g/l. NaOH—120 g/l.	5	115	4.0	4.1
	10	108	10	10
	50	101	13.6	15.8
	100	51	12.4	57.5

The oxidative power of oxygen in alkaline solutions is given as:

III-b $2OH^- = \frac{1}{2} O_2 + H_2O + 2e^-$ $E° = -0.40$ volt

Addition of these two half-cell reactions gives:

III-c $\frac{1}{2} O_2 + CN^- = CNO^-$ $E° = 1.36$ volts

This equation shows that alkaline solutions of cyanides should be oxidized quantitatively by the oxygen of the air and the data in Tables I and III indicate that some cyanate is formed by contact of air with solutions of cyanide. Although the reaction is favored thermodynamically, apparently it does not proceed rapidly under ordinary conditions. However, the effect of catalysts on this reaction has not been investigated; it is possible that certain metals in solution accelerate the reaction rate.

Heat greatly accelerates the rate of reaction between cyanides and oxidizing agents. Electroplaters frequently use cyanide solutions with oxidizing agents such as hydrogen peroxide, and, for example, a mixture of these two materials is used for bright dipping of silver. Solutions of hydrogen peroxide and soluble cyanides when heated to low temperatures such as 130° F. will react so vigorously that the solution may boil over due to violent evolution of gas. It should be emphasized that cyanides are good reducing agents and can react with explosive violence when mixed in the dry state with such oxidizing agents as sodium nitrate, sodium chlorate or sodium chlorite. Perchlorates are even more dangerous. Care should be taken, therefore, in the use of any oxidizing agent with solid cyanides. One eruption occurred with near serious consequences even though the operator thought that he was safe since he was using an aqueous mixture. A mixture of powdered sodium cyanide and sodium nitrate was poured in a processing tank and heat was applied to the bottom of the tank. Even though the salts were covered with water, they had not the chance to dissolve completely and after a short while, the mixture exploded with great violence.

Electrolytic Decomposition of Cyanide Solutions

A study of the decomposition of sodium cyanide solutions was made under various conditions of electrolysis. Equation III-a indicates that cyanides should be capable of being oxidized to cyanates at the anode of an electrolytic cell. If an inert anode (such as carbon) is used, cyanide will be oxidized whenever the anode-solution potential is high enough to allow the indicated to take place. In fact, if the potential is high enough, the cyanide may be oxidized directly by oxygen in accordance with III-c. In one series of tests, carbon electrodes were used and measured 1½ inch × 1¼ inch with ½ of the surface area available for passage of current. Electrolysis was accomplished in 400 ml. beakers with the solution kept agitated by a stirring motor. The temperature was held at 70° F. by means of a water bath and duration of the electrolysis was 4 hours. Table IV shows the results obtained.

From an examination of Table IV, it will be seen that there is a progressive loss in the total sodium cyanide with an increase in current density. It should be borne in mind that the tests were run on an equal time basis and, therefore, a different number of coulombs had been passed through the solution. As in previous experiments, the presence of NaOH reduced the decomposition of cyanide with the exception of the run made at 100 amp./sq. ft. Much greater decomposition occurred at 100 amp./sq. ft. in the sodium cyanide solution containing sodium hydroxide.

Equation III-a indicates that high concentrations of hydroxide ion should promote the oxidation of cyanide to cyanate. However, Table IV shows that the amount of cyanate that was formed nearly was independent of the current density for the NaOH-NaCN solution, and it might be argued that the rate of formation of cyanate is independent of both current density and NaOH concentration. However, a loss of 58 per cent of the cyanide content of the NaOH-NaCN solution did occur at 100 amp./sq. ft. and there were no appreciable gains in NaCNO content. Since at these high current densities the anode interface may become acidic, the cyanate

TABLE V. ELECTROLYTIC DECOMPOSITION OF SODIUM CYANIDE SOLUTIONS*

Solution	Current Density Amp/sq. ft.	Cyanate g/l.
NaCN—120 g/l. .	5	4.0
	10	2.4
	50	1.6
	100	4.8
NaCN—120 g/l. .	5	3.2
NaOH—120 g/l. .	10	2.4
	50	1.6
	100	14.0

*Copper Electrodes—Electrolysis 4 hours at 70°F.

could have been hydrolyzed to ammonia and thus been lost. The carbonate content of these solutions indicated that cyanide was converted to carbonate. In fact, the increase in carbonate content was found to be very nearly equivalent to the cyanide loss.

The data in Table IV indicate that for equal time intervals the cyanide loss increases with the current density. But, more cyanide is decomposed per coulomb at low current densities than at high current densities.

Electrolysis With Soluble Anodes

Electrolytic tests also were made with solution compositions the same as used in Table IV but copper and zinc electrodes were used. An attempt to evaluate the loss in free cyanide would be meaningless because cyanide would be consumed in varying amounts depending upon the variation in electrode efficiency.

Decomposition of cyanide solutions due to oxidation at the anode would vary greatly with the type of anode and the degree of anode polarization. Inasmuch as copper is being oxidized at the anode in a cyanide-copper plating bath, let one determine its half-cell potential. The available data are:

$$Cu = Cu^+ + e^- \qquad E^\circ = 0.52 \text{ volt}$$

$$Cu^+ + 3CN^- = Cu(CN)_3^{--} \quad K = 2 \times 10^{27}$$

For the latter reaction, $E^\circ = 0.059 \log K = 1.61$ volts. Thus, the oxidation of copper is barely preferred over the oxidation of cyanide to cyanate since for the reaction $Cu + 3CN^- = Cu(CN)_3^{--} + e^-$, $E^\circ = 1.09$ volts, while for the cyanide oxidation (III-a) $E^\circ = 0.96$ volts.

If there is not enough cyanide in the vicinity of the anode to form $Cu(CN)_3^{--}$ from copper ions as fast as they are released from the electrode, then $Cu(CN)_2^-$ will form. For this case, the additional available data are:

$Cu^+ + 2CN^- = Cu(CN)_2^-$ $K = 1 \times 10^{16}$; $E^\circ = 0.94$

For the reaction:

$Cu + 2CN^- = Cu(CN)_2^- + e$,

the voltage is, $E^\circ = 0.42$. In this case, the oxidation of cyanide to cyanate is preferred over the oxidation of copper, and it can be said that if large quantities of cyanate are formed this reaction controls the dissolution of copper at the anode.

The potential at the anode in ordinary copper plating solutions increases with current density and at the same time the anode efficiency falls. From Table V it can be seen that the cyanate formation is relatively low with current densities up to 50 amp./sq. ft. but at current densities of the order of 100 amp./sq. ft., appreciable cyanate formation occurs.

Experiments were made electrolyzing cyanide solutions containing zinc electrodes and the results were similar to those reported in Table V for copper electrodes. Ammonia always was found in the solution due to hydrolysis II-a but analytical data are meaningless due to the fact that ammonia was being lost continuously from the solution during the electrolysis.

A comparison of the cyanate data of Table IV with that of Table V indicates that carbon electrodes produce more cyanate than the zinc or copper electrodes. This was to be expected since both zinc and copper are oxidized preferentially at the anode and so the only amount of cyanide that is oxidized is that small quantity which statistically will come into contact with those portions of the anode which are polarized momentarily.

The data of Table V show that a large amount of cyanate is formed in NaOH-NaCN solutions at 100 amp./sq. ft. It will be recalled that the data of Table IV only hinted that this was true.

Reaction of Cyanides With Copper Salts

Before the ready availability of soluble cuprous cyanides, the electroplater had to make his own copper cyanide solutions. A discussion of the reactions involved would be appropriate at this time to point out the hazards present when cuprous cyanide solutions are prepared. If the plater uses copper sulfate, he will be employing a salt that normally hydrolyzes to give an acid reaction. The addition of sodium cyanide to a copper sulfate solution can cause the evolution of hydrocyanic acid. In addition, another reaction proceeds in which copper is reduced from the cupric to the cuprous state and some of the cyanide is lost as cyanogen according to the following reaction:

$$2CuSO_4 + 8NaCN = 2Na_2Cu(CN)_3 + 2Na_2SO_4 + C_2N_2$$

Both cyanogen and HCN are extremely poisonous, and if cuprous cyanide is made from copper sulfate and an excess of sodium cyanide, it should be done carefully with good exhaust ventilation.

If basic copper salts are used, such as basic copper carbonate or copper hydroxide, HCN will not be evolved. In this case cyanates and cyanogen will be formed.

Cyanogen also can be formed by heating certain metallic cyanides, for example, mercuric, gold, and silver cyanides. All of these cyanides decompose on heating to form metal and cyanogen. In aqueous solutions, however, mercuric cyanide is extremely stable.

TABLE VI. ELECTROLYSIS OF SODIUM FORMATE SOLUTIONS*

Current Density	Solution Conc. Start	Formate After Electrolysis	Qualitative Carbonate Test
10	10 g/l.	9.16 g/l.	Trace
100	10 g/l.	0.14 g/l.	Heavy Ppt.
10	100 g/l.	98.7 g/l.	Trace
100	100 g/l.	82.8 g/l.	Heavy Ppt.

*Carbon Electrodes—70°F.—1 Hr.

Auric or trivalent gold cyanide is unstable and like copper the lower valence state is the stable form, namely, aurous cyanide.

Ferrocyanides in Solution

Cyanides are consumed by the formation of ferrocyanides. If ferrocyanides form in plating solutions, iron must enter the solution in some manner. This can occur in at least three ways. One method of entry of iron is the dragging in of soluble iron salts as a result of improper rinsing of acid-pickled parts. Ferrous salts, for example, react with free alkali to form ferrous hydroxide. The ferrous hydroxide then slowly dissolves to form ferrocyanide. Ferrocyanides also are formed by reaction with steel tanks and with anode baskets or iron anodes. They also can be formed by reaction with iron at low current density areas or recesses because alkali cyanide solutions will dissolve iron in the presence of oxygen to form complex cyanides.

Carbonate Formation

Carbonate can be formed in plating solutions in several ways. It can form by displacement of HCN with carbon dioxide according to the following equation:

$$H_2CO_3 + NaCN = NaHCO_3 + HCN.$$

This occurs since the carbonic acid is a stronger acid than hydrocyanic acid. A second method of formation is by reaction between free alkali such as NaOH with carbon dioxide of the air to form sodium carbonate directly. A third source of carbonate is the anodic decomposition of the sodium formate that inevitably forms due to hydrolysis of cyanide in accordance with equation II-a. The fourth method of formation is the decomposition of cyanide at the anode due to oxidation to cyanate and the subsequent hydrolysis of the cyanate ion to ammonia and carbonate.

In regard to the first two methods of carbonate formation that have been mentioned, these continue all the time a plating solution is exposed to the air, and represent the major source of carbonate in plating solutions. The rate of absorption of carbon dioxide is accelerated by air agitation (unless carbon dioxide is removed from the air) and by a mechanical stirring of the solution as, for example, in barrel plating.

The decomposition of formates in solution is excessively rapid at high current densities and when insoluble anodes are used. An evaluation of the electrolytic decomposition of sodium formate solutions was made. A solution containing 10 g/l. of sodium formate was electrolyzed at 10 amp./sq. ft. and 100 amp./sq. ft. respectively using carbon electrodes. The tests were run at room temperature for one hour. Another series of tests was run with a much higher concentration of sodium formate, namely, 100 g/l. at both 10 and 100 amp./sq. ft. No attempt was made to get the exact percentage of formate that decomposed to form carbonate and so only qualitative results are shown in Table VI. It will be seen that there is little carbonate formation at 10 amp./sq. ft. but extensive carbonate formation at 100 amp./sq. ft.

Old plating solutions may contain quite a lot of formate and so the carbonate formation will occur at a relatively more rapid rate in old solutions than in new ones.

In regard to electrolytic decomposition of sodium cyanide solutions to form carbonate, the controlling reactions are the formation of cyanate at the anode and the subsequent hydrolysis of the cyanate to carbonate and ammonia. As was indicated above, a very high current density (about 100 amp./sq. ft.) will cause a rapid formation of cyanate which in turn will cause a rapid increase of carbonate concentration by its hydrolysis. Most plating baths are run at lower current densities and seldom with an inert anode so that the formation of cyanate occurs rather slowly. Furthermore, since cyanates decompose rather slowly, especially in alkaline solutions, only a slow rate of build-up of carbonate can be ascribed to the electrolytic decomposition of cyanide.

Acknowledgment

The authors gratefully acknowledge the aid of Mr. John Leith who assisted in the experimental work leading to the preparation of this paper.

DISCUSSION

MR. A. T. PATTERSON (Patterson Plating, Toronto, Ontario, Canada): With reference to loss of cyanide, there are at least two suppliers of copper plating solutions that recommend air agitation for their copper baths. Is this considered a wasteful practice?

DR. MURACA: It is considered a wasteful practice from just this viewpoint: Whenever the free alkalinity of the bath decreases due to the fact that carbon dioxide from the entering air neutralizes alkalies, then you will actually volatilize hydrocyanic acid, but when you keep the bath sufficiently alkaline, the loss due to volatilization will be extremely low. Due to the fact that hydrogen cyanide may be lost by volatilization, all cyanide baths should be kept ventilated, then it is permissible to use air agitation. I believe most platers do use air agitation without any trouble whatever, but one must make sure the solution is alkaline. We, in our experiments, could find absolutely no losses other than plain volatilization due to the fact that carbon dioxide was being absorbed and the alkalinity of the bath was being decreased. But, as I pointed out, this loss is quite small.

MR. PATTERSON: Because the percentage of carbon dioxide in the air is quite low. Is the loss due to this reason quite small by comparison to other reactions proceeding at the same time?

DR. MURACA: Yes, the loss due to volatilization is almost negligible; I assume you are just bringing it up to point out its magnitude; the chief loss of cyanide is the inevitable hydrolysis to form cyanate and ammonia that seems to be the major loss for any plater.

DR. L. E. LANCY (Ellwood City, Pa.): If NaOH inhibits the breakdown of CN, what minimum concentration is required or, in other words, what should the *p*H be?

DR. MURACA: I believe that would be a function of the type of bath, so I cannot really recommend a value of *p*H to keep that loss at a minimum. Each bath has its own characteristic alkalinity; where the amount of free cyanide is low and the alkalinity of the bath is also low, we get almost no volatilization in spite of air agitation; here the loss of cyanide is due to electrolysis. So in answer to your question, the particular bath you have commands how much free hydroxide is necessary to prevent loss of cyanide due to volatilization.

DR. E. B. SAUBESTRE (Sylvania Electric Products, Flushing, N. Y.): Will you please repeat your argument concerning the effect of hydroxide on cyanate formation, and do you have evidence of its effects?

DR. MURACA: About the only thing I can say on the effect of hydroxide on cyanate is this: that the way the reaction was presented on the slide, you can read into the chemistry of it that the hydroxide concentration increases the tendency for the cyanide to be oxidized to cyanate. I have shown evidence that seems to prove this, except in certain slides where you noticed perhaps that I have indicated that it seemed there was a little more cyanate formation where the hydroxide concentration was very high in the bath; I did not study the question of cyanate formation completely.

MR. H. A. FUDEMAN (Trico Products Corporation, Buffalo, N. Y.): Have you observed or studied in any way the effects of organic addition agents in plating baths on the chemical phenomena just described?

DR. MURACA: No, we have no data whatsoever.

MR. FUDEMAN: What, in particular, would happen?

DR. MURACA: I'd rather not venture to say.

MR. WILLIAM E. TREMBLEY (Texas Instruments, Inc., Dallas, Tex.): How do the ferrocyanide compounds affect cyanide analysis?

DR. MURACA: In the particular cyanide analysis that we use, which is Denige's modification of Liebig's original method, we simply titrate the cyanide with silver in the presence of ammonia and potassium iodide until the appearance of a turbidity of silver iodide. It is not affected at all by the presence of complex cyanides.

MR. TREMBLEY: If you assume that you have a high concentration of complexes such as in the case of high concentration of either ferro- or ferricyanide, would the cyanide which is combined in this compound show up in your total cyanide analysis as cyanide?

DR. MURACA: No, it would not show up.

MR. TREMBLEY: Due to the fact that it is strongly bound?

DR. MURACA: That is right. You see, the only analysis we had here was free cyanide; so you are correct if something had entered into the bath that tied up some cyanide; we would not have found that quantity by our analysis.

MR. TREMBLEY: If this ferri-ferrocyanide combined does not enter into the reaction, what about the other reactions which take place in the bath?

DR. MURACA: The cyanide bound in complexes does not enter into any of the reactions such as hydrolysis, volatilization, and electrolysis.

EVALUATION OF CARBONATE REMOVAL METHODS*

R. SCOTT MODJESKA†

Introduction

At approximately fifteen-year intervals the subject of the removal of carbonates from cyanide soutions is brought before the members of the American Electroplaters' Society. The last series of papers were presented in 1937[1] and 1938[2] by R. O. Hull. In his introduction in 1937, which sums up the problem neatly he said, "One of the results of the operation of cyanide plating solutions is the inevitable tendency toward accumulation or 'building-up' of carbonate in the solution".

Also listed by that author were the principal reactions which produced carbonates within the bath and although these reactions have been printed and reprinted, they are still worthy of repetition. They are:

$$2NaOH + CO_2 \longrightarrow Na_2CO_3 + H_2O$$

$$2NaCN + 2H_2O + 2NaOH + O_2 \longrightarrow 2Na_2CO_3 + 2NH_3$$

$$\left.\begin{array}{l} NaCN + 2H_2O \longrightarrow HCOONa + NH_3 \\ 2HCOONa + O_2 \longrightarrow Na_2CO_3 + CO_2 + H_2O \end{array}\right\}$$

$$\left.\begin{array}{l} 2NaCN + H_2O + CO_2 \longrightarrow Na_2CO_3 + 2HCN \\ 2HCN + 4H_2O \longrightarrow 2HCOOH + 2NH_3 \end{array}\right\}$$

etc.

Hull's presentation covered also the precipitation of carbonates through the use of calcium sulfate. The quantitative precipitation rates are recorded[1] in the 1937 proceedings of the Society and need not be repeated here. However, as a part of the preparation for this presentation, some of Hull's work was spot checked. As expected, no disagreement was found. In his presentation he mentioned also some of the objections to other materials used as precipitates in plating solutions.

At the presentation of the subject paper in 1937, Dr. Blum asked questions as to the relative undesirability of sulfate ions or carbonate ions in cyanide plating solutions. The following year, in discussions during the presentation of papers, Dr. Blum indicated that it took Hull a year to find an answer. Hull replied, "It didn't take a year to have the answer, but it took a year to prepare a paper for answer". And, as recorded in the 1938 proceedings of the A. E. S., he presented[2] a paper on the effects of carbonates and sulfates on the plating characteristics of cyanide solutions.

Subsequent to the presentation of these two papers, DuPont, Udylite, MacDermid, and Lea, in the writing of operating manuals for their proprietary processes, have discussed carbonate removal methods.

Discussion

The question may be asked, "If there has been so much written about carbonate removal, why then, a paper at this time?" Two factors have influenced the decision to review the situation with respect to carbonates. First and foremost is the increased usage of potassium salt solutions. Second, the fifteen-year cycle seems to parallel the rise from foreman plater to plant superintendent, and that leaves the foreman plater receptive to the information with which his predecessor has already been presented.

Carbonate Additions in Laboratory Tests

In the laboratory work preceding the writing of this paper, carbonate increases in cyanide solutions were accomplished by the following methods:

A. Direct addition of the carbonate (either the potassium or sodium salt, depending upon the particular bath)
B. Prolonged aeration
C. Prolonged aeration plus heating
D. Electrolysis
E. Acid additions, to simulate the drag-in caused by inadequate rinsing

Panel Plating Tests

Panels were plated both in Hull Cells and in experimental tank set-ups, using solutions treated by the above methods. Since certain of the methods resulted in a change in concentration of the cyanide, this variable was maintained at as nearly a constant concentration as possible, by frequent analyses.

In all of the solutions, save those with acid additions, the resulting panels were comparable. In other words:

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†Scientific Control Laboratories, Chicago 7, Ill.

TABLE I. RANGE OF CARBONATE CONCENTRATION LIMITS*

Solution	Lower Limit	Recommended Upper Limit	Objectionable Limit
Brass	3.0	8.0	12.0
Cadmium	2.0	6.0	10.0
Copper	3.0	8.0	12.0
Gold	2.0	8.0	12.0
Silver	2.0	8.0	12.0
Zinc	2.0	8.0	14.0

*Values given in oz/gal

the means through which the carbonate increment was achieved had no bearing upon the quality of the deposit obtained. For example: in some instances the solution was evaporated almost to dryness, re-diluted, cyanide concentration was adjusted and a satisfactory plate was still obtained.

In acid drag-in tests, sulfuric acid had little if any effect upon the deposits. However, phosphoric acid, nitric acid or hydrochloric acid exhibited the effects that these ions characteristically produce as contaminating impurities in cyanide plating solutions.

Carbonate Concentration Limits

In considering the removal of carbonates one must first determine what is an objectionable concentration. Mather reported[3] on the advisability of having carbonate present in the electrodeposition of copper from cyanide solutions. Watts, informally, referred[4] to carbonates in the electrodeposition of silver in 1920. Graham spoke[5] on the advisability of carbonates in rochelle salt copper solutions in 1937. Various reporters have listed[6] different upper and lower limits for carbonate concentration while observations at this laboratory have indicated still different tolerances.

These figures differ somewhat from the concentrations listed[7] by other workers. However, based upon frequent observations of more than a hundred different plating operations, these values may be considered as representative. The values listed as objectionable are for concentrations at which lower cathode efficiency, anode polarization, poor deposit characteristics demand attention. The values listed as upper limits are the concentrations which should be maintained in controlled production.

The effects of high carbonates are well known, but they may be listed as follows:

1. They increase anode polarization
2. Reduce cathode efficiency
3. Reduce conductivity (increase resistivity)
4. Reduce bright current density range
5. Increase tendency to spotting-out
6. Cause spongy deposits (particularly from gold, silver and indium solutions), and
7. Increase the viscosity of the solution thus causing greater drag-out losses

Curves showing the relationship of carbonates to anode polarization, and carbonate concentration—specific resistivity relationship have been published[8] and are included as a part of operating instructions for certain proprietary solutions.

While acknowledging the necessity for some carbonates plus listing the limits of concentration as well as the effects of high concentrations, one wonders about methods for the prevention of carbonate increase. In the main, the prevention methods that have been presented are of sufficiently little value that one is justified in passing on to methods for carbonate removal.

Carbonate Removal Methods

Methods for the removal of carbonates may be divided into the following groups:

1. Freezing-Out
2. Chemical Precipitation
   A. Calcium Sulfate
   B. Calcium Hydrate
   C. Barium Hydrate
3. Acid Treatment
4. Dilution

Freezing

"Freezing-out" is probably the oldest method known but is not applicable to potassium salt formulations due to both the greater solubility of the potassium salts, and to the fact that the potassium compound with its high water of crystallization content can be formed only under very special conditions. Theoretically only the sodium carbonate and some complex iron cyanides will separate out from the solution through freezing.

Various researchers report differing temperatures for freezing-out. Some workers suggest[9] 40° F, others suggest[10] 32° F; however, the majority suggest a temperature of 26° F. Observations on the precipitation of carbonates from brass and copper solutions indicate that 40° F freezes out approximately two ounces of carbonates per gallon of solution when this lower temperature is maintained for eight hours. Though the removal of only two ounces of carbonates generally is insufficient, the amounts of metal and cyanide retained in the crystalline mass at this temperature seem to be at a minimum. Freezing can reduce the carbonate concentration to as little as five to six ounces per gallon and some workers report[11] reduction to as low as three ounces per gallon, but in the author's experience it has not been possible to reach this low figure.

In practice the amount of metal and cyanide lost by the freezing method makes the process highly comparable to dilution. Solutions treated by freezing methods were found to yield satisfactory deposits when diluted back to the original volume and electrolyzed though, as indicated, some loss in metal was observed. Freezing, followed by immediate decantation, resulted in losses of metal as high as 80 per cent. However, observations in tests by the author indicate that this

same method in industrial practice has not resulted in losses this great but has averaged approximately 10 per cent. The freezing technique may be used with all sodium formulation solutions though with precious metals the carbonate crystals should be treated for precious metal recovery rather than being discarded as are the common or base metal sludges.

Precipitation with Calcium Sulfate

Precipitation with calcium sulfate has been very well covered by Hull, but since this paper is intended to evaluate, it must be noted that: while calcium carbonate precipitates quite readily and in approximately equivalent concentrations, the addition of the sulfate ion is, in many cases, objectionable. The sulfate ion is objectionable particularly if the solution is contained in a steel tank. In rochelle salt or tartrate formulated solutions the presence of the sulfate ion appears to have a beneficial action. Small concentrations of the ion were found not detrimental to the deposit in any of the solutions examined.

The removal of the sodium sulfate from solution is accomplished through refrigeration of the solution to 40° F. It has been claimed[12] that sodium sulfate is removed sufficiently well over a temperature range of from 40° to 50° F but practice indicates that the lower temperature is more desirable. Less metal and cyanide were lost in the process of freezing-out the sulfate ion than in the carbonate ion separation. In sodium solutions some carbonates were removed by the freezing-out of sulfates but no repetitive results were obtained.

Opponents to the use of calcium sulfate as a precipitant will argue that: due to the necessity of alkali sulfate removal it is, in effect, a two step "freezing-out" method. Of course, they are correct theoretically but incorrect practically since the freezing-out will not remove the carbonates in a potassium bath. Again the separation of the sodium sulfate is easier than is the separation of potassium sulfate due to the lower solubility of the sodium salt.

Precipitation with Barium or Calcium Hydrate

The majority of suppliers of proprietary processes list either barium or calcium hydrate as the corrective material for their particular baths. Precipitation of the carbonate with either barium hydrate or calcium hydrate is especially desirable since they introduce no foreign anion into the cyanide solutions. The carbonate is precipitated quantitatively and, since, the majority of solutions to be treated operate with a free caustic content, the additional hydroxyl ion is not objectionable. However, in the event the *p*H of the solution is raised too high or the concentration of free caustic exceeds the operating limits of the bath (this seldom happens), electrolysis with insoluble anodes or additions of carboxy acid salts may be used to reduce the alkalinity.

In a comparison of costs, barium hydrate is approximately twelve times the cost, per pound, of chemical lime, and, due to the difference in molecular weight of barium and the waters of crystallization in barium hydrate, the per pound cost of carbonate removed by barium hydrate is approximately 48 times the cost of carbonate removed through the use of calcium hydrate.

Experimental evidence supports the recommendations that frequent small reductions of carbonate (2 to 3 ounces per gallon) are advisable since they are more easily and more efficiently accomplished. In general, precipitation methods result in little or a negligible loss in cyanide and metal.

In brass or copper solutions which frequently have the tartrate ion as a part of their make-up, a high carbonate concentration can be reduced through the addition of tartaric acid or potassium acid tartrate and the resultant di-alkali tartrate will be beneficial. ADEQUATE VENTILATION must be observed in acid treatment and, naturally, there are justifiable limits to the tartrate concentration.

Dilution of any plating bath is usually the last resort and though the existence of the method is acknowledged, it is preferred not to consider dilution as a production tool except where the losses encountered can be made up by gains in production.

As a result of experimental data and observations of plant operations, it is the author's opinion that calcium hydrate is the most efficient and, thanks to advances in filtration techniques, the simplest method for the removal of excessive carbonate concentrations from either potassium or sodium formulations.

The removal of carbonates by the use of calcium hydrate proceeds according to the reaction:

$$M_2CO_3 + Ca(OH)_2 \ldots\ldots\ldots 2MOH + CaCO_3$$

Where *M* is either sodium or potassium.

Wherein:

0.70 ounce of calcium hydroxide..... $Ca(OH)_2$

Removes:

1.0 ounce of sodium carbonate..... Na_2CO_3

Liberating:

0.75 ounce of metal hydroxide..... MOH

The procedure for precipitating the carbonate is as follows:

1. The quantity of carbonate to be removed and the amount of lime required for its removal are determined analytically.
2. Solutions are heated to 170°-190° F, with the optimum desirable at 175° F; then slowly a slurry of the lime is added to the plating solution.
3. The bath is agitated for at least two hours.
4. Then the precipitated calcium carbonate is filtered out.

Investigation of methods for the reduction of carbonate in alkaline tin solutions resulted in no completely satisfactory procedure as all treatments reduced the tin concentration by an objectionable amount.

ACKNOWLEDGMENT

Appreciation is expressed to John Pawlak, head of the analytical laboratory at Scientific Control Laboratories for his cooperation in obtaining the corroborating data necessary to this presentation.

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DISCUSSION

MR. E. V. COLLINS (Chromium Corporation of America, Waterbury, Conn.): What method do you recommend for removal of carbonate from silver baths?

MR. MODJESKA: The use of calcium hydroxide has been most satisfactory. Most of the new formulations are operated at high *p*H, particularly potassium, depending upon the formulation.

MR. J. V. MCCANDLISH (Bar-Rusto Plating Corporation, Kansas City, Mo.): Recently, in the literature, a process was described for using carbide for the removal of carbonates. Can you give us any information on that?

MR. MODJESKA: I saw the article—in fact, several articles; in this investigation we did not consider the use of carbide.

DR. LANCY (Ellwood City, Pa.): I would like to answer the previous question and say that calcium carbide may be the very best of the precipitating agents for carbonate. Naturally, with the calcium carbide addition, acetylene gas is generated and an explosion hazard is on hand, thus the additions have to be made judiciously. Just as with calcium hydroxide additions, normally we do not precipitate 2 to 3 oz/gal of carbonate at once, but do it in small increments from day to day. The acetylene gas has to be mixed up with the surrounding air in such a way that we do not generate an explosive mixture. Practical experience indicates that by limiting the additions to 1 lb of calcium carbide to each 5 square feet of tank surface area the danger of explosion can be avoided constantly. The additions should be made when operations are shut down for at least eight hours.

MR. MODJESKA: The producers of several of the proprietary baths have made definite statements against the use of carbide because as the acetylene is given off, it does give the possibility of side reaction with the addition agents.

DR. LANCY: Some carbide has a sulphide impurity present. I would say that no danger did I ever find with its use in the proprietary zinc, or copper plating baths. With silver, gold or brass solutions I would not want to venture to say what would happen.

MR. MODJESKA: In the proprietary high speed coppers particularly, I am thinking of Lea's—I do not want to give any one producer a plug, but I do know that if an operator of a Ronal solution should use some calcium carbide, I am sure the supplier would disclaim any credit or blame for the solution not working.

MR. JULIUS TERES (U. S. Air Force, Wright-Patterson Air Base, Dayton, Ohio): What grade of lime do you use?

MR. MODJESKA: There are one dozen manufacturers to choose from. Any good chemical lime will suffice so long as it is up to chemical specification.

MR. NATHANIEL HALL (Metal Finishing, New York, N. Y.): The subject of precipitation of carbonates, of course, is of interest to practically every plater using a cyanide solution. We have discussed many methods of precipitating carbonate, but I think what the average plater needs is a description of a good method to get calcium carbonate out of the solution.

You speak of precipitating a couple of ounces per gallon at a time in order to prevent an increase in hydroxide concentration, which is very good. But, even the matter of three or four ounces of carbonate, from a practical standpoint, involves so much of a labor charge in connection with cleaning filters, cleaning the bottom of tanks, loss of plating solution, which is practically unavoidable; when you get all through, I think you can question whether it pays to precipitate carbonates or whether it pays to dump some solution and reduce the carbonates that way.

MR. MODJESKA: In the paper proper, we refer to the use of dilution as method of carbonate removal. However, the reason that the cost of filtration was not considered as a factor is that, as all of us know, the frequency of filtration is much higher now. In plants across the country, an ever-increasing number employ continual filtration. We have found that where the filtration is done either on a fixed schedule or is done continuously, the removal of the calcium carbonate is not considered as objectionable. Under the old technique where the facilities were left in the corner until needed, and when something required filtering, 467 pounds of nickel had to be moved to get out the filter, then filtration was a problem. Now, I would say that at least 50 per cent of the plating departments, counting in the job plater as well as manufacturing firms with plating departments, have some filtration going on all the time. I think we can accept the advances in filtration techniques to offset the costs of removing the calcium carbonate.

A FURTHER STUDY ON THE EFFECT OF ABRASIVE METAL POLISHING ON THE CHARACTER OF NICKEL PLATE*

W. L. PINNER†

Abstract

By means of photomicrographs, the character of steel surfaces, created as a result of various abrasive polishing procedures, is shown. The effect of such surfaces, on the quality of electrodeposited nickel, is discussed and certain points are proved by means of additional photomicrographs. The presence of steel slivers and fragmented metal are shown to have an undeniable effect on the smoothness, buffability and corrosion resistance of plated coatings. Certain electrochemical treatments are shown to be beneficial in removing fragmented metal particles prior to plating.

Introduction

This report is a continuation of previously published work[1] related to the effect of basis metal polishing on the character of nickel plate. It will be recalled that the quality of electrodeposited nickel, as measured by the salt spray test, was shown to be influenced by the polishing sequence used on steel. More particularly, it was shown that a final polishing operation with a lubricant was effective in improving the corrosion resistance of the plated coating, and this was demonstrated experimentally to be true regardless of the prior polishing grain size or the created scratch appearance.

In the tentative conclusions previously reported, the statement was made that "pores, scale and similar imperfections in the basis metal exerted a profound effect on the properties of the plate." Another pertinent statement read, "something else besides scratch depth enters the picture." Reference was made to what was then vaguely defined as a smoothening effect on scratches or a rounding off of the scratch tops. The statement that "a relation exists between corrosion resistance and scratch shape or width" may now, it appears, be corrected to "a relation between corrosion resistance and the character of the metal in the scratch." This paper is presented particularly for the purpose of clarifying this phrase. A further object of this paper is to report the effects of metal preparation prior to plating through the inclusion of pertinent information on the use of electrochemical pre-finishing procedures.

Discussion

It is the opinion of the author and his associates that abrasive grain polishing of metals, mechanically is similar to a milling operation, complicated by an ever-changing size and shape of cutting tool. It is known that the mechanism of polishing is attended by work hardening and by heat-treatment of the surface because of the high temperatures which are attained, all of which is visualized to result in metal fragmentation, formation of slivers, plus an unusual amount of oxidation of the surface layer. This theory is borne out by actual photomicrographs of many polished surfaces and is substantiated further by well-recognized effects on plated coatings.

The sketch in Fig. 1 portrays such a conception. Here the individual polishing grain is, in effect, the milling cutter. It should be borne in mind that, in rapid succession, new cutters of different size and shape work on each increment of surface. The combination of such an action together with the embrittlement of the surface layer already referred to, leads one to visualize the effect of slivers and of powdered or fragmented metal on the results previously reported. One also can visualize the possibility of improving the surface character by the use of lubricants during polishing, which, in fact, has been demonstrated and reported.

In the sketch in Fig. 1 the worked layer of metal underlying the chip which is formed, is visualized as being left partly in the bottoms of the scratches. Evidence of this can be seen in the photomicrographs which are appended. Bowden[2] and his associates discussed such a formation during cutting operations, and among others, have shown that in the presence of a lubricant, this type of action is decreased markedly. It is pertinent also to mention an obvious fact that the use of a lubricant reduces the temperature of the surface and thus should be expected to reduce the amount of

*Presented at the Fortieth Annual Convention of the American Electroplaters' Society, June 16, 1953.
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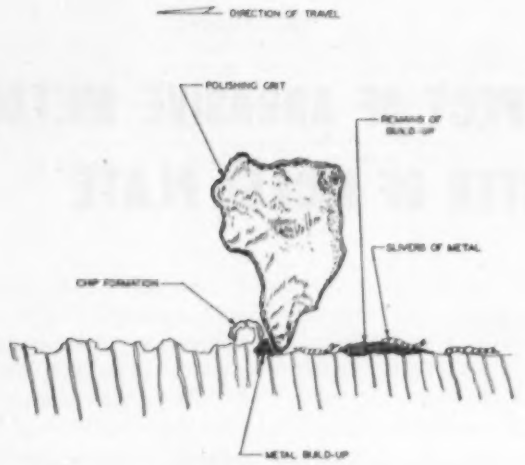

Fig. 1 Artist's conception of the mechanical similarity of abrasive grain polishing to a milling operation

embrittlement which occurs. Both of these observations may well account for the improved condition of the steel with regard to its reception of a better quality nickel plate, which fact, as already mentioned, was established experimentally in the previous report.[1]

In this work, the investigation of surfaces showed these improvements when lubricated abrasive polishing was used, but still left much to be desired as far as a complete cleanup of the metal surface was concerned. It can be visualized that any mechanism should favor improved quality when there is accomplished a thorough removal of all particles which are attached more or less loosely to the surface plus a thorough conditioning of the base metal to receive a good electrodeposited coating. Now it has been demonstrated that the use of electrochemical means to accomplish the above does result in improvement of protective value, improvement in roughness and buffability of coatings such as nickel and improvement in the appearance of bright nickel plate from the standpoint of a more complete elimination of incipient nodules.

In contrast with the previous work, this investigation made no effort to evaluate plated coatings deposited on surfaces of widely different character as judged by scratch size and depth. It did involve an examination of the steel surfaces in the as-polished condition, and, additionally, included observations on the properties of nickel plate on surfaces prepared in various manners, all of which, however, were within a range of final product acceptability as far as scratch-appearance was concerned. There are appended photomicrographs of polished steel surfaces which were cleaned with soap and water and which were photographed by direct vertical illumination.

Fig. 2 shows the character of a surface produced by polishing NAX steel with a No. 60 grit belt which was followed by a single pass on a No. 240 grit belt, both operations in the absence of a lubricant. This surface had a profilometer reading of 72 microinches, and particular attention is called to the general appearance of the surface which resembles in a great many respects that of a plowed field. It will be noted that the tops, sides and bottoms of the scratches show evidence of slivers and of fragmented metal.

Fig. 3 shows a surface produced by polishing with a No. 100 grit belt followed by one pass on a No. 240 grit belt. The profilometer reading on this piece was 37 microinches, containing, as expected, scratches of lesser depth than existed in Fig. 2. It will be seen, however, that the scratch tops, sides and bottoms exhibit the same character as is shown in the previous figures.

Fig. 4 shows the surface produced by polishing on dry No. 180 grit belts. The profilometer reading for this surface was 42 microinches, and it is of interest to note in this regard that the surface produced in this manner contained scratches slightly deeper than those pro-

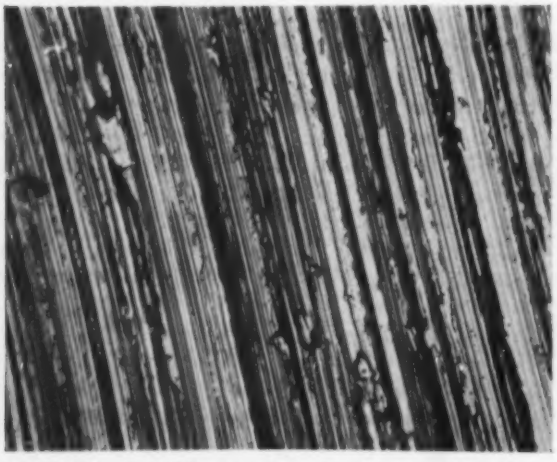

Fig. 2. Polishing sequence: No. 60 plus No. 240, no lubricant (375X)

Fig. 3. Polishing sequence: No. 100 plus No. 240, no lubricant (375X)

duced by a combination of No. 100 and No. 240 as shown in Fig. 3. It will also be noted that there are a larger number of scratches on this surface than in the previous one, but, otherwise the character of these is much the same as those already shown. A very considerable amount of slivers and fragmented metal can be seen on the tops, sides and bottoms of the scratches.

Fig. 5 shows a different type of structure in several respects. This specimen was prepared by using a combination of polishing procedures, involving five passes on a No. 100 grit belt, three passes on a No. 150, one pass on a dry No. 180, and one pass on a No. 180 grit belt using a grease lubricant. The effect of the lubricant immediately is evident in that the ragged, torn appearance which was so evident in the other surfaces is largely eliminated. But, it will be noted that there is ample evidence of slivers which lie embedded in the scratches. It will be recalled that such a surface has already been reported[1] as being capable of receiving a superior nickel plate, but it is also evident that there still remains room for improvement.

For purpose of an interesting comparison, Fig. 6 shows a surface produced on a No. 90 grit using a grease lubricant. It will be seen that the size of the scratches are much larger than those shown in Fig. 5, but that otherwise the character of the surface is more like this one than any of the other photomicrographs. Uncommonly few fragments of metal can be seen, but here again there is ample evidence of slivers which are attached to the surface.

Fig. 7 shows the result of polishing the surface in Fig. 6 with a No. 220 grit with grease as a lubricant. Very obviously the jump from a No. 90 grit to a No. 220 grit is too great inasmuch as there are places where deep scratches were not removed. However, excepting for the presence of slivers, it will again be noted that the surface is apparently superior to that obtained when dry abrasive polishing only was done. This surface has a finish of 20 microinches which barely approaches the

Fig. 5. Polishing sequence: No. 100, 150, 180 plus No. 180, lubricated (375X)

Fig. 6. Polishing sequence: No. 90, lubricated (375X)

Fig. 4. Polishing sequence: No. 180 only, no lubricant (375X)

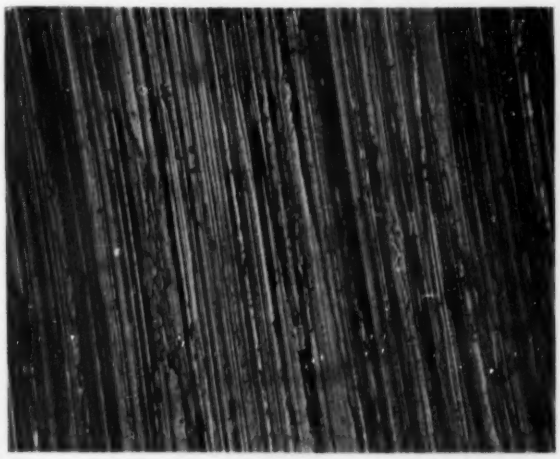

Fig. 7. Polishing sequence: No. 90, lubricated plus No. 220, lubricated (375X)

Fig. 8. Polishing sequence: No. 180, dry plus No. 180, lubricated (375X)

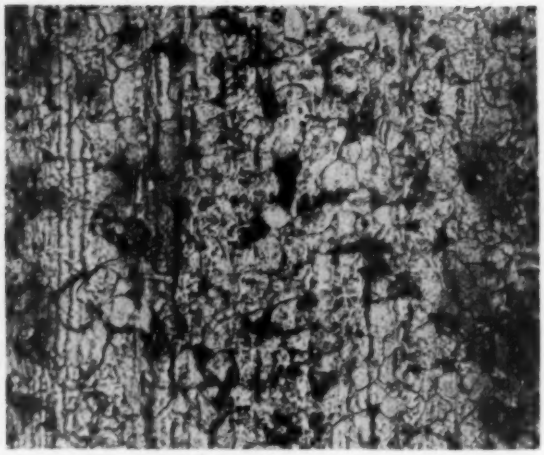

Fig. 10. Polishing sequence: No. 180, dry plus 1½ minute electropolish (375X)

range of acceptability for plated articles such as automobile bumpers.

For comparison, particularly with Fig. 4 and with others, Fig. 8 shows a surface produced by dry polishing with No. 180 grit, followed by a No. 180 grit belt with a greaseless composition. This material has lubricating properties as evidenced by the fact that the same type of surface results as with the use of regular polishing grease.

All methods of mechanically polishing surfaces which appeared to hold any promise were investigated for improving the embedded sliver situation but without any marked effect. The removal of such particles was considered to be desirable on the basis that, theoretically, an improvement should be obtained in the properties of plated metal when deposited on a sound surface free from such particles. After failing to accomplish such removal by mechanical means, the author investigated the effectiveness of electrochemical treatments.

Fig. 9 shows a surface previously polished with a No. 180 dry abrasive and subsequently etched for 30 seconds in a standard anodic sulphuric bath. It will be seen that a large number of the slivers and fragmented metal have been removed. Although it is not a part of this investigation, it is pertinent to mention that it has long been recognized that such an anodic acid treatment is, from other considerations, exceptionally valuable as a means of conditioning steel to receive an extremely adherent nickel plate.

Fig. 10 shows a surface produced by electropolishing over a No. 180 dry abrasive polish for 1½ minutes. The electropolishing operation was carried out in a standard bath used for the purpose, the current density being approximately 200 asf. It will be seen that this treatment has removed substantially all of the slivers and fragmented metal so much so that the surface structure is approaching that of the base metal.

Fig. 11 shows the surface of polished steel which was

Fig. 9. Polishing sequence: No. 180, dry plus 30 seconds' sulfuric acid anodic etch (375X)

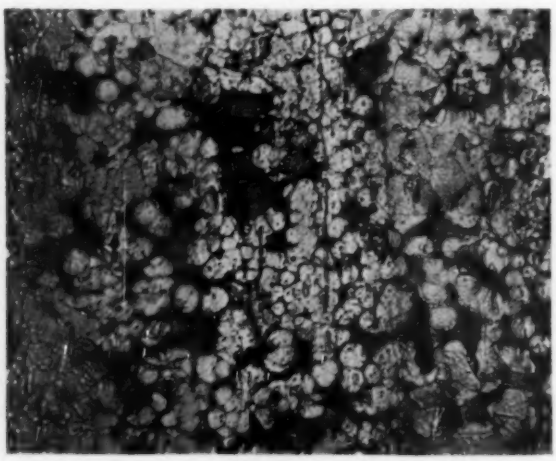

Fig. 11. Polishing sequence: No. 180, dry plus 10 minute electropolish (375X)

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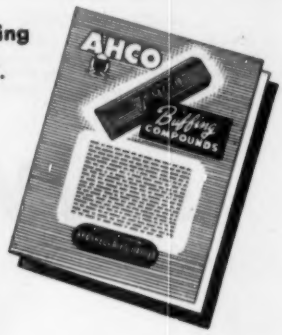

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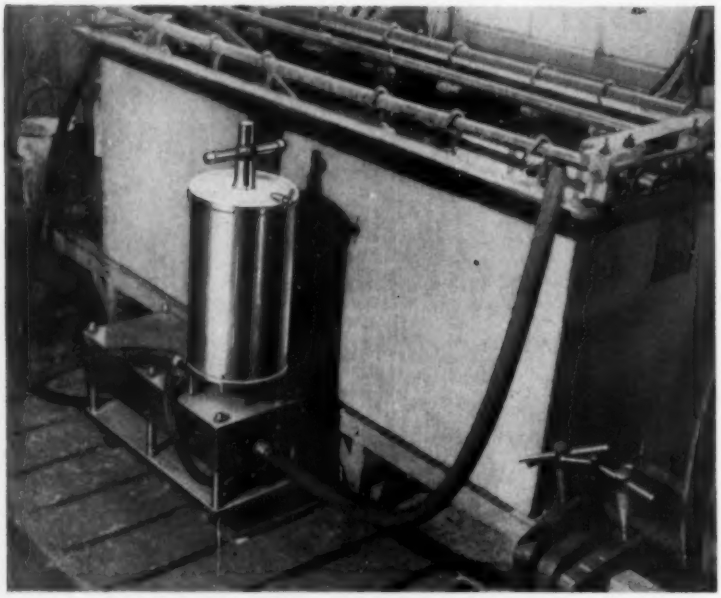

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electropolished subsequently for 10 minutes. It is seen that this further develops the structure of the steel itself. It may be noted that an even longer time of electropolishing produced no further startling change in the character of the surface.

In the experimental work, involving electrochemical treatments, a vast number of panels were prepared in various ways, all falling within a range of profilometer readings from 5 to 20 microinches. The preparation procedures involved mechanical polishing using polishing grease, greaseless compositions and combinations of these with both anodic etching and electropolishing. The work was carried out at a time when the quality of steel was distinctly inferior. It is proper to mention that gross imperfections in the steel itself exerted such a profound influence on the corrosion properties of the nickel plate that these over-shadowed any differences developed in the finishing procedures. Salt spray test results on the several sets of panels involved were meaningless because of scattered results always involving one or more very large rust spots or rusted areas which definitely could be attributed to seams, pits or such similar imperfections in the base metal. Other properties of the plated coatings, as affected by prefinishing procedures, will be described later.

Results were consistent enough to be worthy of presentation only when the polishing of the steel always included a sufficient amount of work to create a surface which, on close observation, was found to have no gross imperfections. Using such material as a basis for further finishing procedures, a noticeably definite pattern was established where the use of a short-time electrolytic acid etch or an electropolishing operation produced a distinctly superior corrosion resistant coating. Little if any difference was noted in the corrosion properties of the nickel plate resulting from the use of polishing grease as compared to a greaseless composition. Likewise, little difference was noted on steel which had been given a 30 second anodic etch as compared to that which had been given an electropolishing treatment, and this was true regardless of the duration of such a treatment. While it is conceivable that a long-time electropolish might give a somewhat superior result based on its accomplishment as viewed microscopically, the actual difference was not apparent in the salt spray test. Thus it is evident that the removal of slivers and fragmented metal, accomplished in a 30-second anodic acid etch, is sufficient to accomplish the bulk of the improvement obtained by such treatment. Strong proof that this is true was also noted in the degree of roughness of the nickel plate obtained with and without such a treatment. This roughness, even on parts given no acid etch treatment, was extremely fine, but a definite decrease was noted on parts which were treated electrochemically. The advantage of such a procedure was even more in evidence on bright nickel deposits which exhibited a distinctly smaller amount of incipient nodules and so-called stardust.

Unquestionable indication of the presence of steel slivers is shown in the photomicrographs represented in

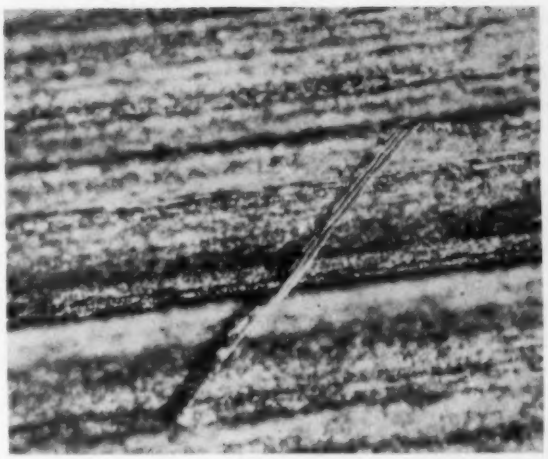

Fig. 12. A steel sliver about 0.003 inch long, at a 45° angle to the direction of polishing (750X)

Figs. 12, 13, 14 and 15. These photographs were made of polished steel surfaces which had been processed through a normal cleaning cycle, such as is used for plating, with the exception that an anodic etch of only 15 seconds' duration had been applied. Apparently this etch was sufficient to loosen up steel particles lying in the bottoms of scratches, but was not sufficient to remove them. Fig. 12 shows a steel sliver approximately 0.003 inch long, lying on the surface at an angle approximately 45° to the direction of polish. This particular sliver appears to be attached rather loosely to the surface of the metal. Fig. 13 shows a sliver approximately 0.002 inch in length, lying at a slight angle to the direction of polish. This metallic particle appears still to be attached to the surface and the crevice in which it did lay can be seen plainly. Fig. 14 shows what are apparently two slivers, both of which are attached at their ends along with the crater from which they were broken loose. On measuring these two me-

Fig. 13. A 0.002 inch sliver lying at a slight angle to the direction of polishing (750X)

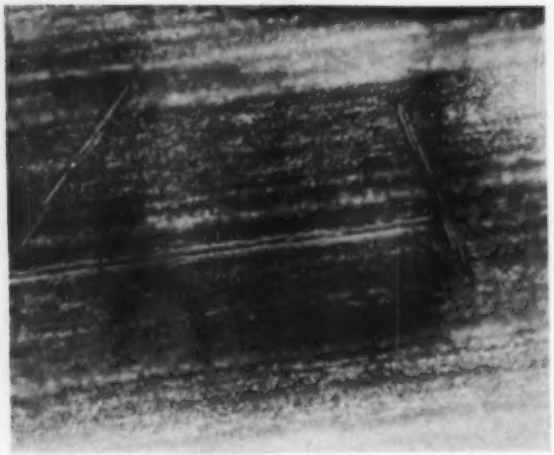

Fig. 14. Two metal slivers still attached to the basis metal (750X)

Fig. 15. Completely detached sliver after short-time anodic acid etch (750X)

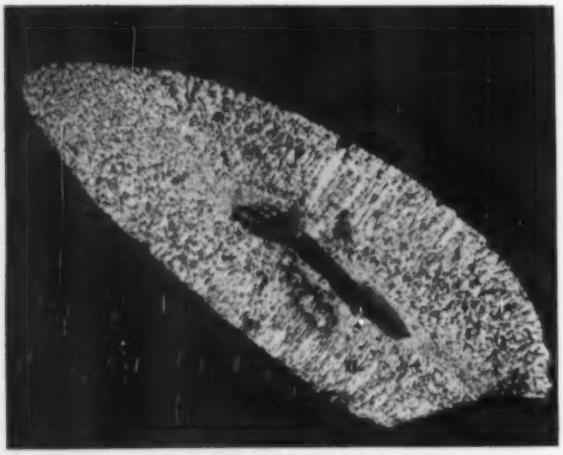

Fig. 16. Detached nodule showing a steel core surrounded by nickel plate (750X)

tallic particles, their length exactly fits the length of the crevice. Fig. 15 shows a completely detached sliver, lying across the metal surface, the particle being about 0.003 inch in length and which apparently has been broken loose completely from the base metal by the short time anodic acid etch.

There is experimental data that more or less firmly attached particles may, during the early phases of plating, assume a position at right angles to the base metal and thus form a nucleus for nodules and create a condition where their removal all the way down to the base metal will occur upon buffing. One might theorize that even if the particle were not removed down to the base metal, that the steel core of the nodule would be exposed on buffing thus permitting corrosion to occur as though there were a pore all the way through the plated coating.

The corroboration that this occurs is based on the observation that at times a very thin plated coating may feel nodular, with projections all out of proportion to the amount of metal which has been plated. Furthermore, some of these nodules actually have been inspected microscopically and have been found to consist of nickel coated steel cores. It is presumed that the stress in the plate or some magnetic activity has caused the steel particles to assume a position at right angles to the base metal.

Fig. 16 is a photomicrograph of a nodule broken off a rough nickel plate. The steel core is seen surrounded by a nickel plate, the columnar structure of which shows a normal arrangement about the center.

With regard to these latter types of imperfections, and as a part of the investigation, a superior cleaning technique was developed in which all of the advantages of the acid etch were obtained and, by which, one disadvantage was avoided. In the use of the sulfuric anodic etch solution, there is a possibility of the development of carbon smut on the surface of the steel, and this material has been known to affect the buffability of dull or semi-bright nickel, and also to affect the appearance of bright nickel. This could occur largely as a result of three factors; the bath composition might be too dilute; the temperature might be too high, and the current density might be too low. Of the above, the first two factors are controlled readily; however, the third may not be controlled so easily on articles of involved shape where it would require an abnormally high voltage and an excessively large source of current supply to insure the required minimum current density in recessed areas.

This objectionable feature can be overcome by the use of a cleaning procedure developed in this investigation wherein the anodic acid etch is followed by a rinse and then in turn by an anodic alkaline electrolytic cleaning operation. Such a procedure results in the removal of the smut from the surface of the steel, which then preferably is rinsed and given a very mild muriatic acid treatment. The surface prepared in this manner retains all of its desirable characteristics for receiving

an adherent nickel coating just as though the anodic acid etch had been used in the conventional manner.

Another incidental observation made during the course of this study related to the limitations imposed on the profilometer method of evaluating surface scratch appearance. Briefly, one or two deep scratches on an otherwise excellently polished surface will give the same profilometer reading as would another surface which contained many fine scratches. On plating, the latter object would have a much better final appearance. This therefore, emphasizes the desirability of having better methods with which to evaluate surface appearance.

Conclusions

In summary, the following conclusions are indicated:

1. Base metal imperfections, such as pits and slag inclusions were shown to have a most pronounced effect on the corrosion resistance of the plate. These defects exerted this influence in defiance of any type of mechanical polish or of any normal cleaning procedure. Either better steel or the complete removal of such imperfections prior to the finishing operations is preferred.
2. Fragmented metal particles produced in abrasive polishing are extremely damaging to plated coatings.
3. Pre-finishing procedures should be designed to remove, as far as possible, slivers of steel and fragmented metal created in the polishing operations.
4. A final polishing operation with a lubricant is effective partially in accomplishing the above.
5. An electrochemical treatment in which the steel is made anodic in suitable acid baths is more effective in removing slivers and fragmented metal.
6. A superior cleaning procedure was developed providing for the use of the anodic acid etch and for the subsequent removal of any carbon smut which might result from that operation.

Acknowledgments

In conclusion the author gratefully acknowledges the permission of the Houdaille-Hershey Corporation to publish the results of this research work. Acknowledgment also is made to the author's associates; namely, Messrs. Charles Conley, William Pierce, Charles Isackson and Arthur Kasper, for their assistance in carrying out the experimental work and in reviewing the paper.

References

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DISCUSSION

Mr. R. A. Dimon (U. S. Steel Corporation, Pittsburgh, Pa.): Have you made any tests on steel panels which have undergone no polishing whatsoever? In other words, do you find slivers on the surface of samples which have not been polished at all?

Mr. Pinner: Yes, earlier in the presentation we stated that it would be preferable to perform no abrasive metal polishing on steel, for best corrosion protection.

Mr. Dimon: I heard that, but I wanted you to make a more definite statement about it.

Mr. Pinner: As a part of a considerable program that we have carried out on corrosion work, we have used cold rolled steel panels on which no work of any kind was performed. As a generality the corrosion protection afforded by electrodeposited coatings, on such surfaces, is best. Unfortunately, however, articles of manufacture have to be bent, stretched, drawn and frequently polished, but we hold to the opinion that better corrosion protection of plated coatings is obtained when these operations are performed so as to effect the least amount of disturbance of the surface.

Mr. Harold A. Kahler (Kaiser-Frazer, Willow Run, Mich.): Did you find the benefits of electroetching reacting the same as on NAX or alloy steel of that sort?

Mr. Pinner: In this particular investigation we used NAX steel only, but we have other information indicating that the benefits of anodic etching are also obtained on other types of steel.

Dr. H. J. Wiesner (Bendix Products Division, Bendix Aviation Corp., South Bend, Ind.): I would like to ask what are the preferred composition and operating conditions of the electroetch?

Mr. Pinner: The electroetch is the commonly used sulfuric acid bath. The acid content should not be less than that which will provide for a gravity of 55° Baumé. The temperature should be as low as possible and preferably not higher than 85° F. The current density is of the order of 150 asf.

Mr. Philip H. Eisenberg (Sylvania Electric Products, Inc., Bayside, N. Y.): In the preferred cleaning cycle was the initial cleaning cathodic or anodic?

Mr. Pinner: The initial cleaning can be either cathodic or anodic. We prefer to use cathodic cleaning because there is a greater evolution of hydrogen at the cathode, which acts as a scouring agent on the work to remove surface dirt. The second cleaner, after going through the anodic etch, must be anodic to achieve the removal of carbon smut.

Mr. Eisenberg: Have you found any evidence when using anodic cleaning that you have loosened up any of these slivers due to the anodic action?

Mr. Pinner: We have not investigated this possibility, but it could very well be that loosening of the slivers might occur in this operation.

PLATING ON MOLYBDENUM*

A. KORBELAK†

Introduction

Among the metals that are used in this country, there are only two whose domestic sources can meet the ever-hungry demands of industry. One of the two is molybdenum, often called "moly" in a shortened version of its chemical name. A silvery white and extremely hard metal with a melting point that ranks fifth highest (see Table I) among the metallic elements, it attracted automatically the probing interest of design engineers in their search for materials of construction for heat engines and other high temperature equipment. One major supplier of the metal reported[1] an increase of 1500 per cent in its production rate over a period of a few years. This figure which dramatically points up the transition of molybdenum from a rare metal status to a vital one in the country's economy is further supplemented by another report[2] which placed the demand for the metal at 500 tons per week. With the increased demand there have been developed a series of manufacturing methods which have wiped out numerous restrictions on ingot sizes, complexity of fabricated shapes and, in addition, with resultant cost reductions.

A conventional method for manufacturing the metal involves the pressing, at pressures of about 20 tons per square inch, a powder obtained by the hydrogen reduction of either ammonium molybdate or molybdenum trioxide.

Chief uses of molybdenum are: a hardening ingredient for alloy steels, mandrel material for tungsten lamp filaments, electronic tube components, welding tip electrodes, electrodes for glass melting furnaces, heating elements for high temperature electric furnaces, mercury vapor light sources, tap extractors, crucibles and as a bonding agent in spray metallizing.

Discussion

As new uses in the high temperature field began to develop, the physical properties of the metal were translated from cold chemical statistics to every day practical applications. The simple statement in chemical texts that molybdenum combines with oxygen to form a number of oxides, does not reveal the full nature of one truly irksome property of the metal. That property is its instability in air at elevated temperatures. Ramage reported[3] that oxides begin to form at a temperature as low as 842°F (450°C.) and that about 1292° F (700°C) oxide sublimation in the form of heavy white fumes is quite rapid. Parke reported[2] that about 1832° F (1000°C), the rate of high temperature corrosion of molybdenum in slowly flowing air is between 0.0003 and 0.0008 inch per minute. Jones, Spretnak and Speiser observed[4] that the rate of oxidation is more rapid in still or slowly moving air than in rapidly moving air.

Fig. 1. illustrates the result of a 15 hour exposure at 1600° F (870° C) in a high velocity air stream. The test bracket was plated with a coating of chromium 0.002 inch thick to retard its oxidation.

The practical effect of this property is that the metal cannot be used above 1292° F (700° C) in an oxidizing atmosphere. Thus, is emphasized the necessity for a protective coating for molybdenum in such high temperature applications if advantage is to be taken of its combination of attractive properties of high strength and hardness coupled with its domestic abundance.

Cladding of molybdenum has been used for some time in the electronic tube industry which utilizes platinum clad rod and wire in the construction of various designs. However, even with such an expensive jacket, there remains the problem of overcoming the diffusion into the core or base of the cladding. Once the surface of such a material becomes rich in molybdenum its behavior pattern follows that of the pure metal. The use of ceramic coatings for protection suffers from the poor mechanical strength of such layers and the added objection of the eventual devitrification of some ceramic formulations.

Methods of Coating Molybdenum

The application of protective coatings on special shapes by other methods is best summarized by the following:

Pack Method: A method of packing molybdenum pieces in powdered chromium, nickel and other metals

*Presented at the Fortieth Annual Convention of the American Electroplaters' Society, June 16, 1953.
†Editor, Plating, Newark, N. J.

followed by heat treatment in high temperature controlled atmosphere furnaces has been used with some success. The biggest drawback to this procedure is that special equipment is necessary and because of the limitations of furnace sizes, large sheets or complex shapes can not be accommodated.

Reduced-Oxide Method: Nickel oxide in a powdered form, dispersed in a suitable vehicle such as lacquer has been used in some applications. The coating may be brushed, dipped or sprayed onto the article which is then heat treated in a reducing atmosphere furnace. The vehicle is burned off, and the reduced oxide film layer remains. This process, in a modified form, is reported by Hansen and Mantell[5] as being used by an electronic tube manufacturer. The modified process involves the application of a coating of nickel and silver oxides which mixture is then reduced by treatment in hydrogen for fifteen minutes at 1742° F (950° C). Other metallic films may be applied to the resultant layer of this jacketing treatment by electroplating. As with the pack treatment method, furnace size limitations and special equipment needs prevent a wider use of this procedure.

Gas Plating Method: The use of gas chromizing techniques have been reported by Lustman and Mosher[6]. This process involved the use of a vapor of a metal halide generated through the action of hydrochloric acid and hydrogen on chromium particles in contact with molybdenum. The deposition of metal layers by the thermal decomposition of volatile metallic compounds, such as carbonyls in an inert atmosphere is covered[7] by U. S. Patents of recent issue.

Diffusion Method: Powdered metal, such as nickel, in a suitable vehicle such as amyl acetate has been applied to molybdenum. The coated item is then heat-treated in which process the vehicle is destroyed, leaving the metal on the surface. A treatment time of 30 minutes at 1832° F (1000° C) results in a diffusion-bonded article of good quality. Objection to this process arises from the roughness of the coating produced and from the requirement of special equipment.

A variation of this method involves the application of a layer of nickel by electroplating—followed up by the atmosphere heat-treatment. The molybdenum in this modified procedure is electropickled anodically at 10 volts in sulfuric acid of concentrations ranging from 1-1 to full strength, rinsed in water, dipped in a mildly alkaline solution, again rinsed in water, dipped in a 10 per cent (by volume) solution of sulfuric acid, water rinsed and then transferred to a warm 110–130° F (45–55° C) Watts' nickel bath. Coatings over 0.00025 inch in thickness were found to separate from the molybdenum upon heat-treatment in an inert atmosphere.

This separation, caused by differences in thermal expansion of the two metals was uniform and concentric on rods and in the form of blistered areas on sheet material. Best results were obtained by bringing up the furnace temperature with the articles being heat-treated. Objections to the diffusion method again arise from the necessity for special heat-treating equipment and the possible change in physical characteristics of the molybdenum through alloying with other metals.

TABLE I. MELTING POINTS OF REFRACTORY METALS

Metal	Melting Points	
	Centigrade	Fahrenheit
Tungsten	3370	6100
Rhenium	3170	5740
Tantalum	2850	5160
Osmium	2700	4890
Molybdenum	2620	4750

Plating Method: The possibilities of developing a good process through plating alone were sufficiently attractive to bring about a study into electroplated coatings on molybdenum. The need for an inexpensive, simple method for coating molybdenum existed even prior to the heat engine era.

Where heat engine applications stimulated a study into the plating of higher melting point metals, electronic applications for ease in brazing or soldering and superior high frequency current conductivity promoted the approach in the field of lower melting point metals.

Conventional cleaning and plating techniques were tried—a wide assortment of pickling solutions, ac-dc treatments, all of which failed to produce any sort of adherent plated coating. Results were poorest with alkaline plating solutions, probably because of the solubility of the molybdenum in such media causing the formation of interfering films on the metal surface. Using such solutions it was seen in operations performed in glass beakers that blisters formed practically immediately in the plating process. The best results,

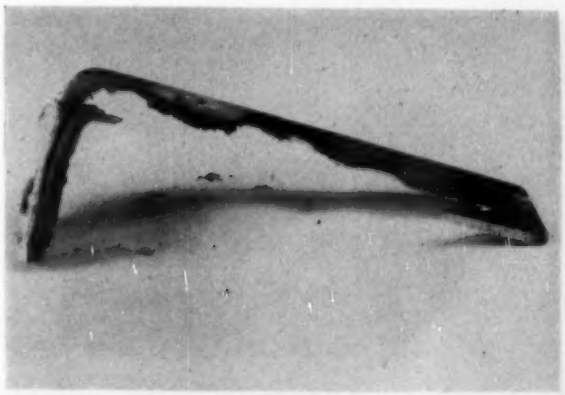


Fig. 1. The result of a 15 hours' exposure test, at 1600° F in a high velocity air stream, of a chromium plated molybdenum bracket

Fig. 2. The result of a 15 hours' exposure test, at 1600° F in a high velocity air stream, of a chromium plated plus ceramic coated molybdenum bracket

appearance wise, were obtained with chromium and nickel plating solutions. With nickel deposits it was found readily that the adherence was only superficial —but could be made entirely satisfactory by heat treating in hydrogen or an inert atmosphere as noted in the section immediately above. With the extra pressure being put forth by the demands of heat engine designers, whose service temperature limits seemingly spiral in a never ending upward climb, the plating approach was levelled at the deposition of chromium because of its properties of higher melting point and hardness. Porosity, the then generally acknowledged structural weakness of plated chromium and the poor distribution of the deposit were overcome for a time by the application on the plated surface of a slurry of powdered glass in alcohol. The glass was fused after evaporation of the alcohol. However, tests that were run on articles so treated showed failure at fairly short exposure periods, though they proved to be a definite improvement over a straight chromium coating. Fig. 2 shows no failure at 15 hours in a high velocity air stream at 1500° F (815° C) though the ceramic layer has been badly distorted.

At this stage in the development work, attempts were made to apply, by electrodeposition, a coating whose composition approached that of Nichrome V—80 per cent nickel, 20 per cent chromium. The excellent service life of this material when used as a resistance heating element in laboratory furnaces that operate at 1832° F (1000° C) and over dictated the attempt in this direction. Accordingly, alternate layers of chromium and nickel were plated on molybdenum to a thickness that totaled 0.003 inch. Fig. 3 is a photomicrograph in cross-section of a test piece prepared in the manner described. The test piece was then packed in chromium powder and heat treated in hydrogen at 2516° F (1380° C) for five hours. Fig. 4 shows a photomicrograph of a cross-section of a specimen taken after the hydrogen firing operation. Studies of these pictorial data showed an interesting and as yet unexplained phenomenon—chromium apparently does not alloy with molybdenum except when in direct contact with aluminum oxide. Fig. 5 shows the same type coating as shown in Fig. 4 after heat treating as above, but in contact with powdered alundum. This singular property was demonstrated in repeat experiments and led to the development of what may be called the chromium strike-bonding technique for the plating of adherent coatings on molybdenum.

Chromium Strike-Barrier Process: It was evident at this time that a chromium plate on properly cleaned metal produced an adherence that would withstand severe bending tests. Proceeding from this fact—and prompted by the requirements of other applications such as brazing, soldering, surface conductivity and others it was a logical step towards the adoption of a chromium strike technique. In this procedure, chromium was plated in the form of a 30 to 60 second flash coating, followed by appropriate rinses and a 30–60 second treatment in a Wood nickel chloride solution. Any conventional plated coating then may be applied on the nickel surface.

Specimens of sheet material were plated using this method with an added nickel coating of 0.0005 inch. Then they were bent repeatedly to the point of fracture of the sheet. Examination of the sheared edges produced no evidence of flaking of the plated layers. In addition to the adherence obtained, there was the benefit of a barrier layer which prevented the unwanted diffusion of other metals, a property of particular importance in certain applications which will be detailed in another section of this paper. Since chromium coatings alone resulted in short oxidation lives in high temperature applications the use of a plated metal which

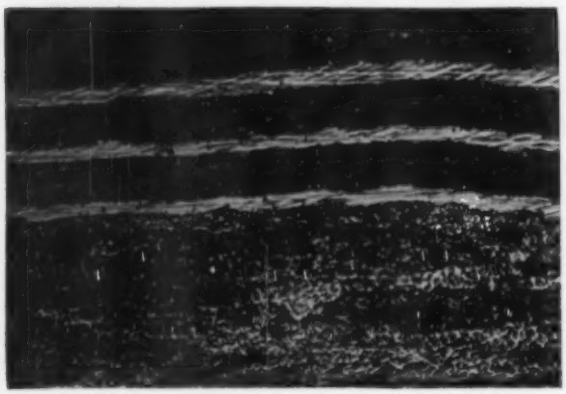


Fig. 3. Cross-sectional view of a test piece plated with alternate layers of chromium and nickel (400X)

offered more in the way of ease of application, freedom from porosity and better rate of deposition was adopted. The behavior of nickel approaches that of noble metals in many corrosive media and was thus the metal of choice in this application.

Chromium-Strike Cycle

The exact cycle that was found to work effectively is as follows:

1. Electroclean anodically in sulfuric acid solution.
2. Rinse in water.
3. Rinse in an alkaline solution.
4. Rinse in water.
5. Rinse in 10 per cent sulfuric acid
6. Rinse in water.
7. Chromium strike.
8. Rinse in water.
9. Chloride nickel strike.
10. Nickel or any other electroplate with pre-rinsing as required.
11. Rinse and dry.

A detailed explanation of the steps in the cycle is provided below with some modifications for special conditions being indicated.

Step 1. The molybdenum first is cleaned free of surface contaminants. Any films of oil or grease are removed by conventional degreasing methods. If the parts are heavily oxidized from an operation involving the cementing or sealing of glass members to the metal it is pre-cleaned preferably in a 10 per cent solution of sodium hydroxide used at room temperature. Treatment in this solution is effected with alternating current at about 25 volts for a period of time about 20 seconds. If the parts are not badly oxidized the step detailed immediately above may be omitted and the following one used directly after degreasing. The part is cleaned anodically in a solution of sulfuric acid ranging from concentrated down to 2 parts acid—one part water. Voltage requirements vary from 24 volts at the higher concentration to 10 volts at the lower values. Current densities range from 100–300 amperes per square foot. Treatment time of approximately 30 seconds is adequate. The molybdenum will be electropolished to a bright mirror finish by this operation and a film of blue oxide will form on the metal. Contamination of the acid with copper will cause the formation of a brown smut on the parts which will interfere with the following plating steps. Build up in molybdenum metal was not analyzed for to a fixed amount since acid bath life was found to last through the processing of thousands of parts. However, if the same acid solution is being used for stripping of nickel or the electropickling of nickel parts a high molybdenum content will result in pitting of the nickel. Temperature variations of the acid solution from 70° F to 90° F (20–32° C) were found to produce equally good results.

Step 2. This is a simple rinse which removes most of the readily soluble blue molybdenum oxide.

Step 3. Traces of oxide which are not always removed by water rinsing are thoroughly dissolved by immersion in practically any alkaline solution. The author used a number of proprietary cleaners with equal success and since spent alkaline cleaners are available generally, it is recommended that such material be used. Solutions of tri-sodium phosphate and sodium hydroxide also may be used. Elimination of this step will cause erratic results where maximum adherence is needed.

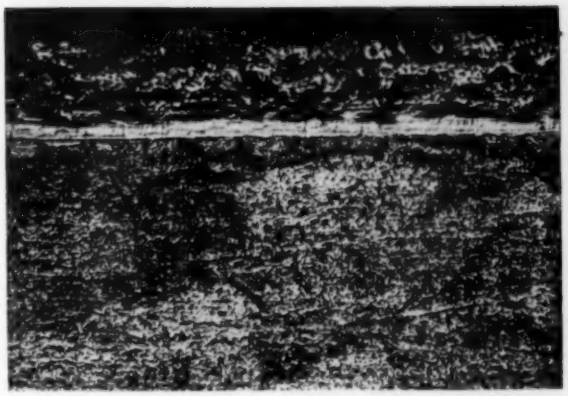


Fig. 4. Photomicrograph of piece prepared in a manner similar to the one shown in Fig. 3. Shown here is the diffused layer that resulted after a high temperature hydrogen baking operation (480X)

Steps 4, 5, 6 and 8. These are conventional good practice as generally employed in cleaning and plating cycles.

Step 7. Chromium strike in a standard chromium plating solution for about 60 seconds at approximately 150 amperes per square foot is adequate. Heavier strike coatings also may be employed. It was found that a solution heavily contaminated with copper and iron did not cover molybdenum parts in lower current density areas. The temperature at which the chromium solution is operated was found to be important.

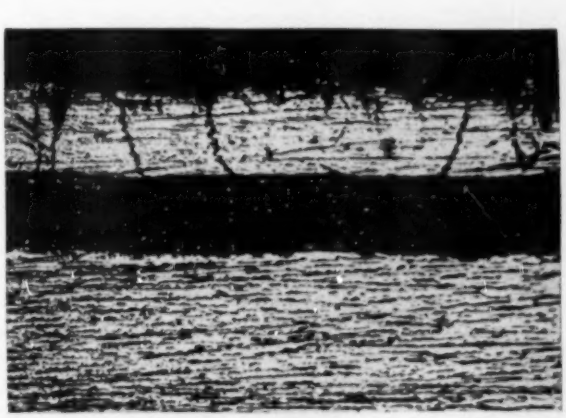


Fig. 5. Cross-sectional view of result of hydrogen baking operation when plated layers were in contact with alundum (400X)

Fig. 6. High-wattage mercury vapor lamp, one of the items on which the chromium strike technique has been used successfully

Peeling of the deposit was found to occur when the bath temperature falls below 120° F (50° C).

Step 9. The nickel-chloride strike bath must be used to get adherence on the chromium film. Copper impurities will result in dark to pink coloration in low current density areas and may result in blistering of subsequently plated coatings. A current density in this step of about 50 amperes per square foot produces good results, though as low as 25 amperes per square foot have been found satisfactory.

Step 10. Any desired plate may be applied to the molybdenum processed as described. Intermediate rinses in water after the chloride strike may be omitted if a final nickel coating is applied.

An analysis as to why the chromium strike technique works in bonding electrodeposits to molybdenum may be partially answered for either, and probably, for both of the following reasons: Only two of the plateable metals, iron and chromium have structures that match the body centered cubic crystal structure of molybdenum. Also the thermal expansion coefficient of chromium is closer to molybdenum than that of the other plateable metals. See Table II.

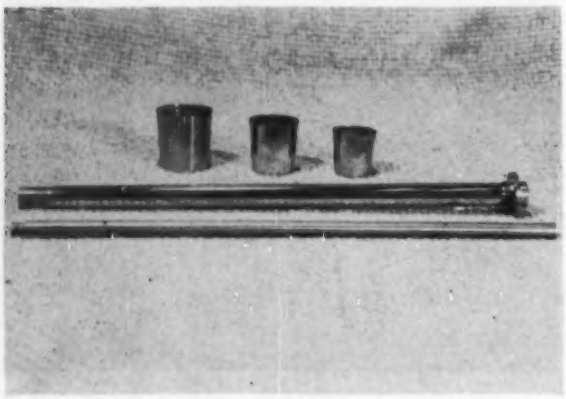
TABLE II. COEFFICIENTS OF THERMAL EXPANSION

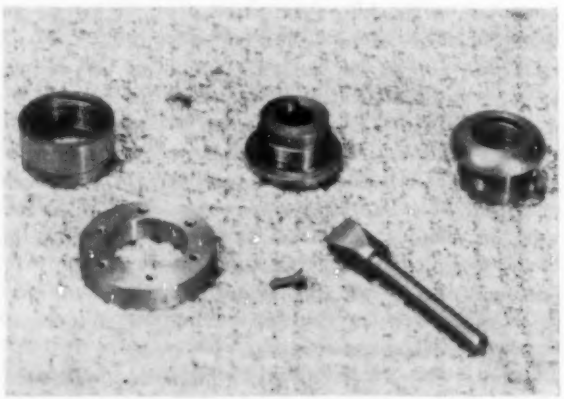
Metal	x 10^{-6}
Molybdenum	4.9
Chromium	6.8
Iron	11.4
Nickel	13.0

Dubpernell furnished information that tends to confirm this theory. He stated[8] that the chromium structure changes when the deposit is applied from a solution operated below 120° F (50° C). The peeling of plated coatings using the chromium strike technique, but at a chromium plating temperature below 120° F has been observed by the author and by Swift[9]. On the other hand, the crystal matching theory appears to be set back by a report from Friedman who stated[10] he had poor success adherence-wise using iron electrodeposits on molybdenum. This may have been because of the iron plating solution used since Vaaler, Snavely and Faust[11] reported good adherence of iron deposits on molybdenum.

Application of the Method: There are numerous applications for parts of molybdenum processed as described. Since the method does not involve any special equipment it can be utilized by most shops. Of currently topical importance are those applications involving heat engines. Certain temperature recording or signalling devices can be made of structurally strong molybdenum and, being plated with a diffusion barrier, protection can be extensive.

Resistance welding tips are more intimately joined to holders through the use of such a plated coating. A copper plated surface layer assures a good brazed





Figs. 7, 8. Electronic tube components which have been plated with adherent coatings through use of the chromium strike technique

joint with all voids eliminated along with potential hot spots that tend to reduce tip life.

High wattage mercury vapor short-arc light sources (see Fig. 6) utilizing a series of glasses graded for thermal expansion characteristics to obtain a vacuum seal with quartz envelopes, have been using the method rather successfully. Without the protective electroplate threaded sections of the device would smoke away during glass sealing so that an original 10/32 thread would accept an 8/32 connector, and poorly at that.

Electronic applications are numerous. (Figs. 7, 8). Soft soldering of small components becomes a simple job. Brazing of complex and large sized units at temperatures close to 1832° F (1000° C) have been produced repeatedly.

The problem of skin effect is now an easy hurdle for molybdenum plated with copper, silver or gold—a procedure which previously could not be done economically.

In the construction of electronic tubes, grid wires of platinized molybdenum are employed to obtain desired thermionic emissivity characteristics. Diffusion of the platinum coating into the molybdenum core results in tube failure occasioned by high secondary emission. To maintain the superior emission suppression property of platinum for a longer time it is suggested that a material utilizing a chromium barrier will be successful.

Certain glass melting furnaces operate more efficiently with electrodes of molybdenum. (Fig. 9). However, service life is seriously shortened by oxidation at the air-glass level. A means of solving this problem is offered through use of the chromium-bond-barrier plating method. Since metals other than platinum tend to discolor optical glass melts—a layer of platinum fixed over and around the plated molybdenum may prove to be the answer in this troublesome application.

The method may also find uses in the plating of molybdenum alloy steels. Where peeling or blistering is encountered on high molybdenum steels—it is suggested that the chromium strike technique be employed as a means of overcoming poor adherence.

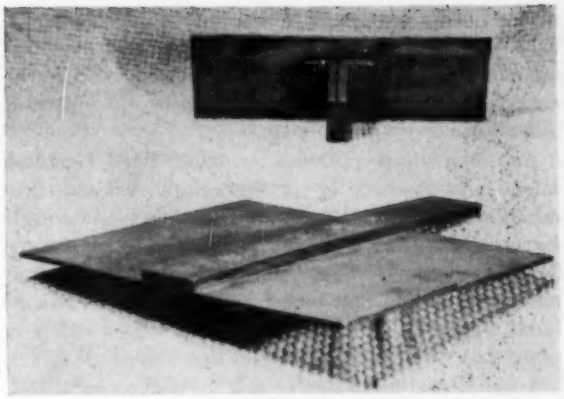


Fig. 9. Electrodes of molybdenum such as are used in glass melting furnaces

Acknowledgments

Certain portions of the subject matter outlined above have been set forth in the author's application pending before the U. S. Patent office and assigned to the Westinghouse Electric Corporation. The author also wishes to acknowledge the assistance and co-operation of the personnel of the Engineering Departments of that company where the photographs used to illustrate this paper were prepared.

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DISCUSSION

Mr. Morton Schwartz (Surface Alloys Engineering Corp., Los Angeles, Calif.): The formation of "blue oxides" in the anodic acid treatment is important from our experience. If the brownish films are formed then difficulties arise resulting in non-adhesion.

Mr. Korbelak: We experienced the same results and did some work which led us to believe that metallic impurities in the acid solution such as copper caused more frequent formation of brown oxide films.

Dr. Cloyd A. Snavely (Battelle Memorial Institute, Columbus, Ohio): I would like to add a few comments to Mr. Korbelak's excellent presentation. This problem of plating on molybdenum is very important to electroplaters because a few wrong moves can lead to failures, which give a bad name to the whole field of plating. I hope every plater who attempts to plate on molybdenum will have a copy of Mr. Korbelak's paper or other good reference material on hand.

In work at Battelle, we confirmed Mr. Korbelak's findings that a flash of chromium is very helpful in obtaining adhesion of nickel plate on molybdenum.

In testing chromium and nickel-plated molybdenum specimens, sometimes we found failures which could not be explained until we sectioned the specimens and examined them metallographically. Often, the molybdenum contained long stringers of oxide, which were

exposed at the surface. The electroplate did not bridge these inclusions and failure started around them. At one point in our work, we had to stop and wait for an entirely new supply of molybdenum because of these difficulties.

An interesting phenomenon that Mr. Korbelak might have observed in his composite nickel and chromium plates is that the chromium, being a strong oxide former, will extract oxygen from the nickel layers. There seems to be a very decided advantage to alternating chromium and nickel. Apparently, the nickel holds up much better if it is deoxidized. Healing of pores may occur more readily in this condition.

I would also like to point out the difference in testing conditions used in various investigations of plating on molybdenum. Some tests have required 1000 hours at an elevated temperature, and others only 100 hours at temperature. It would be helpful if the testing procedures were made more definite than they are at present.

MR. KORBELAK: I see Mr. Friedman in the audience. I know he is familiar with current testing techniques, and he may wish to add a few remarks.

MR. ISIDORE FRIEDMAN (Wright Aeronautical Division, Curtiss-Wright Corporation, Wood-Ridge, N. J.): First, I would like to commend Mr. Korbelak on having presented such an excellent paper. Now we, too, have had these variations in requirements for temperature-time exposures. Changes in temperature requirements from 1800° F on up, and exposure times from 25 hours to 500 hours are not uncommon.

In connection with the comparison of composite nickel-chromium coatings against straight chromium, it is interesting to note that for a deposit of the same thickness, that is 0.001 inch, we were able to get 14 hours exposure time at 2000° F, as compared to 10 hours for a straight chromium deposit at the same temperature.

DR. SNAVELY: The work we did at Battelle was recently released in an AEC report. Dr. L. E. Vaaler of our staff developed a ferricyanide etch, which seemed to be very helpful. Otherwise, the results were about the same as Mr. Korbelak's.

MR. KORBELAK: Were you able to confirm the barrier property we found in this work with chromium?

DR. SNAVELY: No. I didn't mention this because our test temperatures were somewhat different from yours. After treatment at 1800° F, we definitely observed diffusion of chromium into the molybdenum. I doubt that any aluminum oxide was present in our work. Nickel, of course, diffused much more rapidly. The diffusion areas in both cases appeared to have undesirable physical properties.

MR. EDWARD F. KOETSCH, JR. (Springfield Armory, Springfield, Mass.): I would like to ask if you have had any occasion to strip the nickel from molybdenum, and if you have, how do you do it?

MR. KORBELAK (holding up sample): This piece is a graded seal of several high temperature glasses joined to quartz. The technique described in the text was used in the assembly of the unit, and as a result of the high temperatures used during that assembly operation, the ends were heavily oxidized. The coating was stripped off with anodic sulfuric acid treatment, then the ends were replated using the chromium strike technique.

DR. FREDERIK S. SCHULTZ (General Electric Co., Cincinnati, Ohio): I would like to add a comment to Dr. Snavely's remarks: The life of these coatings depends very much on how you test them and the method of test should depend on the end use. For instance, a nickel coating 3 to 5 mils thick might last 800 to 1000 hours on static oxidation at 1800° F. If cooled intermittently its life will be much less because the protective oxide will spall off due to the fact that NiO is oxidized to Ni_2O_3 at approximately 400° C and at 600° C goes back to NiO. There is a volume change which accompanies this reaction causing the loss of the protective oxide.

I would like to ask you a question: Have you studied any oxidation rates on these coatings—that is, the nickel-chromium combinations?

MR. KORBELAK: Early in these high temperature studies of coatings on molybdenum, when the requirements of the Services called for 24 hours at 1800° F, we were able to obtain a life of 300 hours with a 3 mil nickel coating on a chromium base. Without the chromium, life at this temperature was but 24 hours.

DR. SCHULTZ: Do they have an alloy that will not recrystallize at these temperatures?

MR. KORBELAK: None that I know of.

MR. STANLEY J. KLIMA (Sperry Gyroscope Co., Great Neck, N. Y.): What would be the best material to use for racking molybdenum parts plated by the procedure outlined in your paper?

MR. KORBELAK: To prevent copper contamination of the anodic etch, simple contact points comprising phosphor-bronze connected through a sleeving arrangement to tungsten tips were used; then the entire contact except for the tungsten tip was coated with a stop-off lacquer; such a contact works well and incidentally also works beautifully in the electropolishing of stainless steel parts where copper contamination would be troublesome.

MR. KLIMA: The next question is in regard to the chromium bath—what is the upper operating temperature limit?

MR. KORBELAK: I suggest that you use your conventional operating temperatures, but would not go below 120° F. If you operate at 130, I would continue to work at that temperature. I would add to that answer, following what Mr. Dow said here this morning, that the possibilities of crack free chromium in this application certainly should prove interesting and now that initial data have been presented, further work in this field should result in some interesting figures.

MR. KLIMA: With reference to chromium-nickel or chromium-nickel-copper multi-layer plating on molybdenum, how critical is the plating thickness of the nickel-copper to prevent the formation and diffusion of chrome oxide when the parts are assembled by means of silver or gold brazing operations in a tank hydrogen atmosphere furnace where water vapor is present?

MR. KORBELAK: That would depend on the initial thickness of chromium and the treating time and water vapor present in the hydrogen. A recent article in PLATING* listed data which are similar to those involved in your question.

MR. KLIMA: In Step 1 of your procedure, is the concentration of sulfuric acid expressed as two parts acid to one part water by volume or weight?

MR. KORBELAK: Volume.

MR. KLIMA: With regard to cleaning oxidized molybdenum prior to the plating procedure outlined in your paper, would it be good practice to first clean molybdenum parts in a hydrogen atmosphere furnace to remove trapped oxygen or to reduce oxides? If so, how dry must the hydrogen atmosphere be, i. e., dewpoint −60° C or could tank hydrogen be used?

MR. KORBELAK: If you were going to do any work involving sizeable pieces that represent a lot of money and time to assemble, a good safety step would be to pretreat your molybdenum piece in hydrogen with a conventional amount of moisture content. Any occluded foreign material would generally clean up in a 30 minute treatment of 1800° F. Longer or shorter treating times should be established by trial runs.

MR. KLIMA: What type of bath did Mr. Friedman use to obtain iron electrodeposits on molybdenum?

MR. FRIEDMAN: That was a standard ferrous chloride, calcium chloride bath.

DR. SNAVELY: Iron in contact with molybdenum is very bad where elevated-temperature oxidation is a matter of concern. I certainly would not recommend iron plate on molybdenum, even though the lattice parameters of the two metals are in the right range to expect an adherent plate.

MR. EVERETT F. CARTER (Sylvania Electric Inc., Towanda, Pa.): Dr. Snavely mentioned this, but we didn't get any response to speak of. In your work on electroplating of molybdenum, did you find that molybdenum base material from different processes would tend to give you various degrees of success in your plating line?

MR. KORBELAK: The quality of the molybdenum definitely fits into the picture.

MR. CARTER: In your work, actually, most of the molybdenum you used, I take it for granted, was Westinghouse?

Mr. KORBELAK: Yes.

MR. CARTER: And that work had not been done on molybdenum produced from other sources?

MR. KORBELAK: The work described in the paper was limited to Westinghouse material. Other investigators in other units of the company may have used molybdenum from outside sources.

MR. W. B. STEPHENSON, JR. (General Electric Co., Evendale, Ohio): How do you overcome racking marks on your molybdenum? We find a lot of times we get excellent results on panels we have plated, except where we have racked them and although we try to reverse them at times, we have plating troubles.

MR. KORBELAK: On the large cylinder you saw, we shifted the contacts about 45° under water, using rubber gloves, by simply twisting it on the rack without taking it off the rack. Then we applied another chromium strike on the first chromium strike, which dulled the plate. The same shifting technique was followed through in the other plating operations.

MR. STEPHENSON: You do not get any peeling between the two chromium layers?

MR. KORBELAK: No.

MR. STEPHENSON: What metal did you use in contact?

MR, KORBELAK: Tungsten tipped phosphor-bronze, or phosphor-bronze alone.

MR. STEPHENSON: To what do you attribute the blistering of nickel plate when plated directly on molybdenum?

MR. KORBELAK: Molybdenum is oxidized in transport through air and since the oxides are not soluble in the nickel plating solution, they represent an interfering film which prevents good bonding.

MR. STEPHENSON: You feel that the chromium will remove the oxides prior to the beginning of the plating action?

MR. KORBELAK: Yes

MR. STEPHENSON: In heat treating in hydrogen, is the temperature critical—about what range do you finish it?

MR. KORBELAK: I take that question to mean where we diffuse nickel into the molybdenum directly?

MR. STEPHENSON: No, you made some statement of plating with chromium, and then nickel over the chromium, and then various other plates; then you heated the whole thing.

MR. KORBELAK: That type of coating was treated at the melting point of the nickel-chrome alloy, 1380° C.

MR. STEPHENSON: Do you find perhaps lower temperatures give you better results or worse?

MR. KORBELAK: They were not tried.

MR. E. R. BOWERMAN (Sylvania Electric Products, Inc., Bayside, N. Y.): *Communicated.* Our laboratory has found that when the anodic sulfuric acid is warm, as when a new solution is prepared, the chromium frequently is non-adherent. This trouble disappears after the acid solution is cooled to room temperature and adherent deposits are obtained. Have you observed any such behavior?

MR. KORBELAK: No.

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*November, 1952, Page 1222.

NEW YORK BRANCH HOST

41st Annual A. E. S. Convention

JULY 12-15, 1954

From July 12 to July 15, 1954, the New York Branch will be host for the American Electroplaters' Society Convention—a role the third largest branch last played sixteen years ago. Those members who attended the Silver Jubilee Convention in 1937 and those who have read and heard about that affair will have some idea about the forthcoming session. As usual the hard-working New Yorkers are planning a four-day event of exceptional technical and social interest. Sparking the efforts of the Branch is George Schore, General Chairman of the Convention Committee. The names of the committee members will be published in later issues of this journal. However, it is desirable at this time to focus attention on a special committee which has been formed under Mariano Ranno; the committee being known as the Visitors Entertainment Committee. The function of this group will be to procure tickets to any shows, ball games and other entertainment in New York. A fishing party also can be arranged if desired. "Moe" has promised to "get them anything they want". A future release will cover the operation of this committee more fully.

As for the city itself, the following outline of background data is presented to give the prospective conventioneer the latest on the biggest city in the country.

New York—The Magnificent

New York, gateway to America, began to function as a port more than three hundred years ago when Henry Hudson sailed up through the Narrows and discovered a harbor that undoubtedly seemed to him a navigator's paradise. New York has since grown to be an empire in itself, embracing within the environs of the port district almost ten per cent of the nation's business. New York has been called the most dramatic city in the world. The appellation may be justified either on the basis of the mushroom character of its growth as compared with an old-world metropolis or on the sudden grandeur of the spectacle which is seen by the visitor from the sea when he catches a glimpse of the towers, one-sixth of a mile high or more, which make the first view of the Island of Manhattan unbelievably strange and beautiful.

The city itself has within its outlines approximately 8,000,000 people. The heart of the city is situated on an island 13½ miles long with a breadth of 2¼ miles at one point. Surrounding the city itself is another broad area with more waterways, more rivers, more bays, more tunnels, marvelous inter-connecting railroads, highways, and great terminals for freight and passengers. This, the whole area, comprises the Port of New York District, and within it dwells a population of upwards of 11,000,000 people.

The Port of New York is the gateway. Beyond is the hinterland of America, reached by railroads and great highways going out from New York like spokes from the hub of a wheel. To the north, three hours away from the city are the Catskill Mountains, one of the summer playgrounds of the people. To the northeast is New England, another combination of agriculture and industrial territory, with the Berkshire Hills, the Green Mountain and White Mountain ranges, and the lakes of Maine. To the west are the Poconos.

And now as the newest attraction New York City offers the United Nations where world history may be seen in the making.

Educational and Recreational Facilities

New York City combines with its finance and its industry marvelous facilities for education and play. It is the home of no less than thirty-seven institutions of higher education.

There are many institutions besides colleges which contribute to New York's cultural side. There is, for instance, the Metropolitan Museum of Art with its magnificent exhibits of painting, sculpture, tapestries, potteries, laces, antiques and miscellaneous objects. There is the American Museum of Natural History with its unusual collection and exhibits of mammals, birds, minerals and other objects of scientific interest. Here, the history of man may be traced through the eons of time.

New York's skyscrapers are among the marvels of the world. Tallest of them all is the Empire State Building at Fifth Avenue and 34th Street which is 1,472 feet high.

New York's bridges constitute another group of wonders. Across the East River is the Brooklyn Bridge, the first of the great suspension bridges to be built. Crossing the Hudson River at 178th Street to Fort Lee, N. J., is the George Washington Bridge, one of the latest of the great bridges to be built and considered by many to be the most beautiful suspension bridge in the world. Its total length with approaches is over 12,000 feet.

Many of the entertainment features cited above are to be had free or at a nominal cost, but in the field of professional amusement, the city out-distances any other in America. There are something like 100 theatres for the production of first-class shows, musical or dramatic.

In the field of music, New York's position is equally important. It is the home of the Metropolitan Opera Company, which numbers among its members many of the world's greatest operatic singers and which furnishes each season a program which can be equaled nowhere else in America.

The city has three major league baseball teams which compete during the summer in great arenas given over to this form of sport.

Race tracks in the neighborhood of New York furnish the sport of kings. There are scores of golf clubs in or near the city which make it possible for a very large proportion of the population to enjoy this form of sport. Daily, vessels leave the port for deep-sea fishing excursions. Beaches to the east and south of the city are both clean and safe and are always crowded during the summer.

All in all, in New York City one can find almost anything to see, hear or do.

project no. 6

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FRICK CHEMICAL LABORATORY

PRINCETON UNIVERSITY, PRINCETON, N. J.

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POROSITY OF ELECTRODEPOSITED METALS

XII. MEASUREMENT OF SURFACE ROUGHNESS AND ITS CHANGE IN EXPOSURE

Introduction

Previous Project work has led to the recognition of two types of corrosive attack, surface and depth corrosion. The latter attacks at discrete points, broadening existing fine pores or producing further porosity, finally causing "failure" where the base metal has been laid bare and directly accessible to the corrosive agent. On isolated foils, the progress of that depth corrosion can be followed by means of measurements of permeability to gases. On adherent deposits, at advanced stages, it can be followed by means of quantitative chemical analysis of the base-metal corrosion products formed at the surface of the depth-corroded coating. Surface corrosion, which can be measured by the classic method of change of weight, leads to failure only indirectly, insofar as it causes the protecting metal coating to become progressively thinner and thus hastens the progress of depth-corrosion. The effectiveness of surface corrosion in hastening the development of depth corrosion and early occurrence of local failures will depend on the extent to which that attack is nonuniform. Clearly, preferential surface-corrosion of discrete areas of the coating must result in regions more vulnerable to earlier failure through depth corrosion. Evidently, then, it is of interest to have means of evaluation of the distribution of the surface corrosion from the point of view of its uniformity. One possible approach to this problem will be outlined in this communication.

Determination of True Specific Surface Area

It is well known that the *real* surface area of an electrodeposited metal generally is greater than its apparent, or geometrical, surface area. The ratio of real and apparent surface area is termed the *roughness factor*, and will be designated by R. A perfectly even surface has $R = 1$. Glossy deposits have a small and dull deposit a higher R. The natural roughness is evidently an important characteristic property of a deposit. Currently used methods of its determination, such as Brush analysis or profilometry, admittedly are unsatisfactory.

The BET Method

There exists, however, a reliable quantitative method of determination of the true specific surface area of a solid, known as the Brunauer-Emmett-Teller, or, in abbreviated form, the BET method. Its application to the determination of the true specific surface area of an electrodeposit will be described in the following. Determinations of the specific surface area, and hence of the roughness factor R (the geometrical surface area being known) at different stages of an exposure, should provide direct numerical information about the distribution of the surface attack in the given corrosive medium: absence of a change will indicate practically uniform surface corrosion; a decrease of R with the progress of the exposure amounts to preferential attack on and

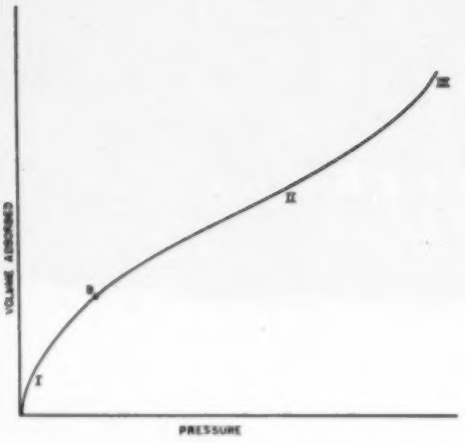

Fig. 1. Adsorption isotherm

leveling of protruding parts of the surface, whereas an increase of R indicates multiple preferential attack on discrete regions, which, as shown above, should be conducive to earlier depth corrosion and local faulure. The behavior of the surface roughness of a given deposit should depend on the specific nature of the corrosive medium and generally cannot be predicted. This makes it all the more imperative to obtain and collect the necessary information experimentally. Its absence can be attributed only to the inadequacy and uncertainty of the mechanical methods heretofore used. The method reported in this paper should open the way to systematic investigations in this direction.

Principle of the Method

It has been long known that, at sufficiently low temperatures, a solid surface will adsorb a gas, and that the amount of gas adsorbed per unit *true* surface area of the solid increases with the pressure of the gas. That low-temperature adsorption of gases is called "physical" adsorption, which expresses that it involves no chemical interaction between the gas and the solid. The curve representing the variation of the amount of gas adsorbed (usually expressed in cc of the gas, measured under a pressure of 1 mm of mercury) with the pressure, at constant temperature, is termed the adsorption isotherm. Generally, the adsorption isotherm at low temperature has the form shown in Fig. 1. It consists of an initial curved portion I, which, at a point B, goes over into a rectilinear portion II, which, at still higher pressures, once more curves upwards (III). Both experimental facts and theoretical considerations[1] have led to the conclusion that, along the branch I, a single layer of adsorbed gas molecules is being built up gradually on the solid surface, and is completed at the point B. The amount of gas adsorbed at that point is exactly the amount necessary to cover the whole available (true) surface area of the solid with one continuous layer of gas molecules. If the pressure is increased beyond that corresponding to point B, a second layer is started, and so forth. The important point is B, i. e., the point where the rectilinear portion of the adsorption isotherm begins. If one determines that point, one knows the amount of gas, and, hence, the number of molecules of the gas, necessary to cover the whole surface with one and only one layer of gas molecules. And if, on the other hand, one knows (from other sources) the dimensions of a molecule of the given gas, i. e., the area occupied by one molecule, one can deduce the unknown surface area of the solid. That is the BET method.

Application of the BET method

The choice of the gas to be used and of the constant low temperature is dictated by the nature of the solid surface with which one deals. It was found convenient to use normal butane (n–C_4H_{10}), at the temperature of melting diethyl ether, −116° C, following the procedure of Wooten and Brown[2].

The apparatus is represented schematically in Fig. 2.

The sample of the deposit, of known geometrical surface area, is rolled and placed in the tube Q which is then sealed onto the apparatus. The whole system to the right of the three-way stopcock G is evacuated to about 10^{-4} mm mercury, then the Dewar flask T is replaced by a small furnace and the tubes Q and N are heated to 450° C and the pumping continued until the vacuum reaches 10^{-6} mm mercury. This outgassing process may take 30–40 hours. It may be preceded by a reduction of the original (unexposed) foil in a hydrogen stream at 400° C for four hours.

Butane (of about 99 per cent purity) from a tank is admitted after evacuation through the stopcock B, purified and dried in C and D, and condensed in the liquid-air cooled trap E. The Dewar flask S is then removed and part of the butane in E is allowed to evaporate through the mercury lock F. The middle portion is collected in the gas buret H.

The temperature in the adsorption tube Q is controlled by immersion in the Dewar flask T containing diethyl ether and provided, at its bottom, with a glass spiral through which liquid nitrogen is admitted so as to freeze out some of the ether and thus keep the liquid ether in equilibrium with its solid phase. The adsorption tube Q and the tube N must be immersed in the *liquid* ether and not come into contact with the solid, or else their temperature might fall below −116° C.

The outgassing and evacuation completed, the furnace is replaced by the Dewar flask T with the melting ether, and the mercury locks K and L are raised so as to admit, through the stopcock I and the capillary R some butane into N (where it is condensed) and the communicating McLeod gage F. The butane is admitted until its pressure reaches 0.169 mm mercury, which is the equilibrium vapor pressure of butane at −116° C. The mercury lock M is then raised so as to isolate the adsorption tube Q from the rest of the system, and the mercury lock K is lowered so as to draw some butane into the McLeod gage J, after which K is raised again and the pressure in J is measured; that pressure is represented by p_o. If, now, K M is lowered, the butane in J expands into Q, and a new pressure p is established. The amount of butane adsorbed by the sample is $= p_o x_o - pv$,

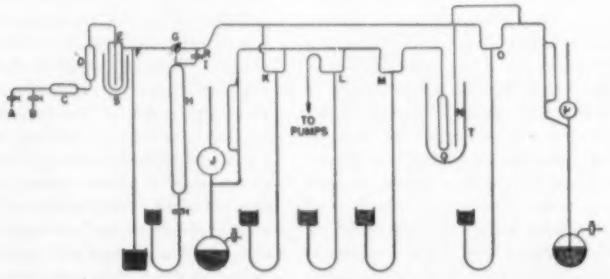

Fig. 2. Apparatus used for gas adsorption measurements

where v_o is the volume of J and v is the volume of J and Q combined*.

A series of such measurements made at different decreasing pressures p permits location of the point B (Fig. 1), i. e., of the amount adsorbed at a stage when the whole surface is covered with just one layer of butane molecules. The true surface area of the sample then can be calculated from the known dimensions of the butane molecule: 1 cc/mm of butane (i. e., 1 cc measured under 1 mm mercury) adsorbed is equivalent to 104.4 sq cm surface area. Division of the true by the geometrical surface area gives R.

Example

A Watts' nickel deposit of 12.5 microns (one-half mil) on two sides of a one-mil rolled-nickel foil, of a total apparent surface area of 400 sq cm, had initially R = 2.15, i. e., a true surface area more than double its geometrical surface area. Measurements after stated times of exposure to hydrochloric-acid vapor gave the following values of R:

Hours of exposure	R
0	2.15
10	2.58
20	3.76
40	4.00
60	4.15

There is, consequently, a rather strong initial roughening up of the surface, which tends to level off with the progress of the exposure. The total increase of the true surface area amounts, roughly, to a doubling of the initial area. Repeated observations with the same type of deposit in the same corrosive medium gave data of the same order, both for the initial R and its subsequent behavior, which thus appears to be characteristic of that deposit in that exposure.

Conclusion

The method described in the foregoing permits quantitative measurements of the mean roughness of a large area of a deposit, and of its changes under given exposure conditions. Roughening of a metal surface in corrosion can be looked upon as a phenomenon intermediate between uniform surface attack and local (pinpoint) corrosion in depth.

References Cited

[1] P. H. Emmett and S. Brunauer, J. Am. Chem. Soc. **59**, 1553, 2682 (1937); S. Brunauer, P. H. Emmett, and E. Teller, J. Am. Chem. Soc. **60** 309 (1938).

[2] L. A. Wooten and Callaway Brown, J. Am. Chem. Soc. **65**, 113 (1943).

*The small error committed by assuming the pressure in Q at −116° C to be the same as that in J at room temperature is negligible.

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readers' questions of general interest

Q. 168. We are attempting to improve the appearance of a certain line of steel hinges (which are copper plated, sulfided, wire brushed, and lacquered) by ball burnishing the copper plate. Can you give us a satisfactory method for removing the film of burnishing compound so that the sulfide coating will have good adhesion?

A. In all probability, a soap film has been left on the copper after the ball-burnishing operation. This may be due to incomplete rinsing after burnishing, or due to the use of soap or a burnishing compound with insufficient detergent action. Either a suitable burnishing compound should be used and the work rinsed well after the tumbling operation, or else the work should be cleaned with a mild alkali soap cleaner after burnishing. At this point the work should be cleaned free of water breaks before any coloring operation is attempted.

Improper cleaning or the presence of oil or soap residues will produce a nonuniform job in the sulfide coloring treatment.

When a sulfide treatment is used on copper, the solution should be very dilute, approximately 1/8 to 1/4 oz polysulfide per gallon, and the bath preferably operated at room temperature. The more dilute solutions produce a black coating which forms more slowly but gives a finer, harder and more adherent deposit. If the coating is formed in too concentrated a solution, the coating tends to be spongy, soft, and somewhat flaky. Some operators add a small amount of ammonia to the sulfide bath, although in most cases this is not necessary.—A. S. KOHLER.

Q. 169. Stainless steel is a material which is easily available now in our country and we are therefore anxious to have your advice on the use of stainless steel tanks for plating solutions of chromium, nickel, silver, zinc, gold, lead and platinum group metals.

A. Unlined tanks for plating solutions are not generally recommended. Stainless steel tanks have been used for silver, gold, zinc (cyanide) and other plating solutions. However, it is advisable to use lined tanks wherever possible and by that is meant an insulating lining. Of course, it is still common practice to use lead lined steel for chromium plating solutions even though the lining is conductive. It is suggested that stainless is satisfactory in any oxidizing type solution, such as nitric acid, but that it should not be used for solutions containing halides. If you are to use unlined tanks stainless is not needed for zinc, tin or cadmium cyanide solutions because steel is less expensive and perfectly satisfactory.—D. GARDNER FOULKE.

Book Review

DR. HAROLD J. READ

Professor of Metallurgy, Pennsylvania State College

QUANTITATIVE ANALYSIS by Harvey Diehl and G. Frederick Smith, vii + 539 pages, 1952. John Wiley and Sons, Inc., 440 Fourth Avenue, New York 16, N. Y. Price $5.00.

Introductory presentations of the fundamentals of quantitative analysis, suitable as textbooks for a two-semester college course, are by no means uncommon, and many of them are very well written. A newcomer to the field must, therefore, withstand careful scrutiny of its own merits as well as detailed comparisons with its predecessors.

As a former teacher of quantitative analysis, this reviewer was favorably impressed with the pedagogic possibilities of the book. The authors' style, which is simple, clear, and to the point, seems admirably suited for the reader whose scientific background is still in the early stages of development. More specifically, however, the integration of theory and practice is excellent, and the value to the analyst of a sound theoretical background should be apparent to the reader. A book on analysis should be just that and not a text on physical chemistry with a few analytical procedures tossed in as interpolated paragraphs in small type or as an appendix to the main portion of the book.

Although somewhat more space is devoted to volumetric methods than to gravimetric procedures, the latter are discussed first, thereby opposing a tendency which has developed in recent years. The authors have returned to the older order of events after thorough teaching experience with alterations in the order of presentation.

The first two-thirds of the book covers general background and operations as well as gravimetric and volumetric analysis. The remainder comprises several chapters on more specialized subjects, such as colorimetry, electrodeposition, determination of *p*H and methods of effecting separations. The latter is splendidly written and should help greatly to give the student a sound approach to the more profound problems of analysis. Chapters on the complete analysis of brass and limestone illustrate the practical aspects of problems in separation.

The text closes with a discussion of accuracy, precision and confidence limits. It would appear desirable to introduce this material at an earlier stage in the presentation, e. g., after the chapter on calculations, for students should have the benefit of it early in their practical work in the laboratory.

The clarity of presentation and completeness of the book, along with the abundance of excellent problems, should make it useful to the metal finisher who is seeking to broaden his technical horizon by self-study.

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Equipment and Supplies

E—1035. Permanent Anode Rod Insulation—A new type of anode support, which provides permanent insulation of anode rods from plating tanks, has been developed for an improved model of the Daniels Type OLS barrel by Daniels Plating Barrel & Supply Co., 129P Oliver St., Newark 5, N. J.

This newly designed support, which is now being used on all type OLS barrels, in addition to the permanent insulating feature, offers the advantages of simple replacement and greater current carrying capacity.

The permanent insulation is achieved since the support requires no holes and is held in position by a set screw (see illustration showing front end of the support). The back support (not shown), which is larger, is adapted for fast, easy connection to a bus bar. Complete information on this improvement and its applications is available upon request from the manufacturer, or through use of Reader Service Card.

E—1036. Redesigned Laboratory Electric Ovens—Blue "M" Electric Company, 306 P, W. 69th St., Chicago 21, Ill., announces the release of its newly redesigned series of electric utility laboratory gravity ovens for analytical laboratory and general laboratory work in the chemical, medical and metallurgical field, involving baking, drying, preheating, aging, sterilization, conditioning and tempering.

This new design eliminates any need for more than one oven—streamlined throughout with the main objective to supply a utility oven more versatile—with greater ease of operation.

These ovens feature protected control components, power selector switch, Fiberglas insulation, and an automatic hydraulic control which permits a sensitivity of plus or minus ½° C. For more data on these ovens use Reader Service Card.

E—1037. New "Plastic Unit Process" Reactors—A new type of equipment for processes requiring high chemical resistance is now available. It may be used for treatment of highly active liquids such as fluoboric, hydrofluoric, and organic solvents; ion exchange, ion exclusion, separation of rare earths, counter current, tower operations, etc.

The "Poly Pup" Reactors are available from 3.5 inches to 22.5 inches OD in heights of 16 inches, 32 inches and 48 inches, and custom sizes.

A most striking feature of the "Poly Pup" reactors is that they are shockproof and non-brittle. Constructed of polyethylene, they are streamlined for ruggedness and simplicity and the interior is easily accessible for inserting or removing contents and for cleaning.

Further information may be obtained by writing Enley Products, Inc., 254 P Pearl St., New York 38, N. Y., or by using Reader Service Card.

E—1038. Heavy Duty Electrolytic Cleaner—More thorough removal of stubborn and heavy deposits of organic and inert foreign matter from metal surfaces preparatory to plating is facilitated by use of Klem cleaner "197".

Klem Chemicals, Inc., 14401P Lanson, Dearborn, Mich., advise that "197" is for use on ferrous metals and may be used with either direct or reverse current. It also is reported to have exceptionally high conductivity qualities and long life.

Polishing and tumbling compounds that harden and are difficult to remove from pits and crevices are among the types of soil more readily freed by use of the new material. For further information, address the manufacturer, or use Reader Service Card.

E—1039. Compact Vapor Degreaser. The recently introduced Manpro B-121 vapor degreaser provides quick, thorough vapor cleaning in one compact unit. Dirty parts or assemblies are clean, warm and dry in less than 50 seconds. Outstanding features are 2 vapor controlling condensers; large work clearance; divided tank to provide boil sump and spray-pump sump; pressure spray; and 2 safety thermostats. Easily installed in 15 minutes, the unit requires only 220 volt single phase electrical outlet and standard water supply, thus saving man hours, needless handling.

For more information on this equipment write Manufacturers Processing Co., 1360P Hilton Rd., Detroit 20, Mich., or use Reader Service Card.

E—1040. New Bright-Nickel Plating Development—What may be the most significant development of the year in the electroplating industry was disclosed by Hanson-Van Winkle-Munning Co. when it announced the development of a new bright-nickel process called Nickel-Lume. The new organic-type process produces better and brighter nickel coatings, is cheaper to operate and is easier to control than other commercial bright-nickel processes now available.

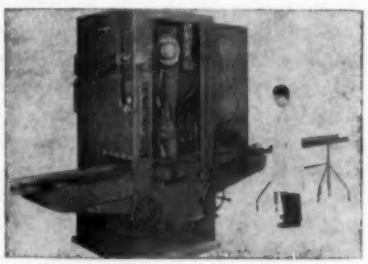
Both installation and operating costs are lower. Equipment suitable for a Watts' nickel bath is all that is required. Ordinary auxiliary equipment may be used, filtration may be either periodic or continuous, ventilation is not required and heat demands are up to 25 per cent lower.

Deposits with the Nickel-Lume process have: bright white color, well-leveled surfaces, low internal stress, good ductility, and highly active surfaces. For more information on this new process, use Reader Service Card.

E—1041. Stainless Pump—The availability of a new type of stainless steel pump is announced by Vanton Pump Corp., Empire State Building, New York. Incorporating the unique features of the standard Vanton self-priming design, which eliminates stuffing boxes, gaskets and internal check valves, the new "S" series permits pumping of a wide variety of chemicals.

Since the only parts in contact with the fluid are the stainless steel body block and the corrosion resistant precision molded, durable flexible liner, these pumps are adaptable particularly for extreme corrosive service. Application data concerning service recommendations are available on request, or through use of Reader Service Card.

E—1042. Coated Abrasives Grinding—Aluminum extrusions are widely used in the manufacture of metal doors, window frames and ornamental trim. These items are normally given a satin or anodized finish, which requires preparatory grinding, sanding or polishing.



Because these extrusions usually come in 21-ft. lengths, the handling problem for any form of grinding has heretofore been difficult and costly.

The operation can now be performed at substantial saving in production cost with the Curtis Straight-O-Matic machine in conjunction with Carborundum's abrasive cloth belts. This setup, accomplishes the polishing of extruded aluminum so rapidly that it has eliminated the five to six back-

Are you handling *production metal cleaning* and *floor maintenance* in your plant with a view to

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You can never be sure that even so-called "safety-solvent" cleaners will be handled with the care required, and you may not be using a safe oil and grease absorbent on your floors where fire hazards exist. Here are two ways to reduce the chances of disaster in your plant:

1 Use Wyandotte metal cleaners in water solutions; they are completely nonflammable. Whether your operations involve hand, tumble, soak, spray or electrolytic cleaning, there are efficient Wyandotte metal cleaners, for use in water solutions, that eliminate the chance of fire or explosion in your plant from this source.

Cleaning between manufacturing operations. Wyandotte alkaline cleaners are, of course, completely nonflammable. Wyandotte emulsion cleaners, particularly NORDALL*, are exceptionally safe with high flash points and very low volatility. When used mixed with water in spray-washing machines, fire hazard is practically nonexistent.

Rustproofing after cleaning. Water solutions of Wyandotte products, like R-2 or PRE-FOS*, or water emulsions of products such as NORDALL, give excellent protection to cleaned parts without the dangers inherent in solvents or oils.

Cleaning and phosphating before painting. Completely safe paint preparation is possible when you use Wyandotte PRE-FOS in soak or spray-type setups. Another product used in water solution in hand-wipe preparation.

Paint stripping. Both Wyandotte alkaline and organic solvent-type paint strippers are nonflammable.

2 Wyandotte ZORBALL, the outstanding all-purpose floor absorbent, does not support combustion. Oil spillage around machines and tanks and under conveyors is many times unavoidable. Wooden block floors, in particular, may become thoroughly oil soaked in a short time. These are well-known danger points. You can combat them with Wyandotte ZORBALL — it will not support combustion even when saturated with oil, paint, solvents, grease. It remains skidproof; will not break down, mud, cake or dust. Harmless on all surfaces, it is the most effective, safest, lowest cost floor absorbent you can buy.

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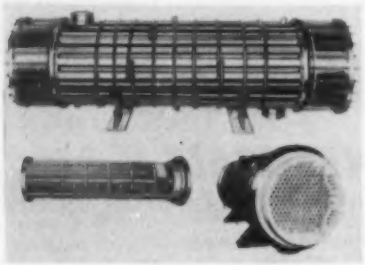
Equipment and Supplies

stand operations formerly needed to meet production requirements. For more information write to the Carborundum Company, Niagara Falls, N. Y., or use Reader Service Card

E—1043. Safety Cans—A new color, flame red, now features Justrite safety cans in all sizes, it was announced by the Justrite Manufacturing Company, 2061 N. Southport Ave., Chicago 14, Ill.

Factors in the selection of the new color were instant identification, high visibility and sharp contrast to fire fighting apparatus. The new finish eliminates any possible confusion between regular fire fighting equipment and the Justrite cans which, in most cases, are used for flammable liquids. For more information on this equipment use Reader Service Card.

E—1044. New Line of Heat Exchangers—A new standard line of pressure heat exchangers designed to pass corrosive liquids or gases under pressure at high temperatures through tubes or shell has been announced by Haveg Corp., Marshallton, Del.

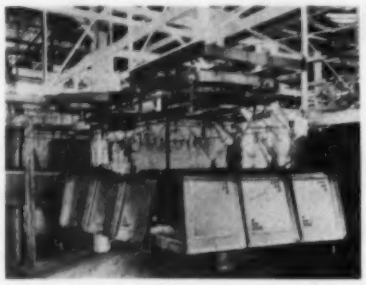


Modled from Haveg, an acid-digested asbestos bonded with synthetic resins, and competitively priced, the new line offers distinctive advantages in extended service life and resistance to corrosion.

Standard pressure sizes range from 13¼ to 29¼ inches inside diameter with single or multi-pass interchangeable heads. Since the material is molded, larger sizes up to 10 feet in diameter can be made for coolers and low pressure heat exchangers.

Pressure ranges of the new standard line are from 50 to 75 pounds per square inch with a wide margin of safety. Haveg is resistant to thermal shock and can be used safely, continuously in temperatures up to 265° F. For more information use Reader Service Card.

E—1045. Variable-Speed-Drive Conveyer—Expensive chipping and dents caused by jerky conveying of porch glider seats and backs through paint spray booths has been ended for one large metal furniture manufacturer. This was achieved through installation of the Logan Jr. Caterpillar variable-speed-drive conveyor. Logan Company, Louisville, Ky., manufacturers of gravity and power conveyors, selected a standard cone-drive



double-enveloping worm gear speed reducer to provide the money-saving smooth operation. For more information on this equipment, use Reader Service Card

E—1046. Buna N Hard Rubber Pump—The Vanton Pump Corp., Empire State Building, New York City, announces the availability of its new PXHR series pumps which utilize a newly developed Buna N hard rubber body block for withstanding temperatures up to 225° F, as well as the corrosive effect of many acids, caustics and organic solvents.

The design of the Vanton pump eliminates stuffing boxes and shaft seals of any sort as well as the need for check valves or gaskets.

The pump which has found wide acceptance in pumping hydrochloric acid, hydrofluoric acid, sulfuric acid and many other highly corrosive chemicals, was formerly available only with a polyethylene and graphite filled Bakelite. For more information on these pumps use Reader Service Card.

E—1047. Kling Oil—On literally hundreds of lubricating applications, where manual application of lube oil is involved, the time required to maintain adequate oiling of equipment adds up to surprisingly large amounts. The fact that ordinary lubricating oils tend to run off and dissipate in a relatively short time, makes it necessary to repeat the hand oiling operation again and again in the course of the day's work.

Magnus Kling-Oil, made by the Magnus Chemical Company of Garwood, N. J., is a No. 30 SAE lube oil with the added property of "tackiness." When applied to a bearing, the oil clings to the surface . . . does not drip or splatter, and maintains ubricity for much longer periods.

Kling-Oil was first tried by one manufacturer nearly two years ago. Now it is used exclusively for his machines. One application per day is ample to keep the units functioning at top capacity and maintain cool bearings, whereas with a formerly used lubricant once-hourly oiling was necessary. For more information on this new lubricant, use Reader Service Card.

E—1048. Immersion Heater—A new flanged tubular-type electric immersion heater has been added to the Chromalox line of electric heating units. It supplements the present series of immersion units used for heating water, oil or paraffin by providing higher heat output and a new size flange, 5-⅜ inches in diameter.

Heating elements of the new unit are available in two sheath materials, copper sheathed elements brazed to a brass flange and steel sheathed elements welded to a cast iron flange. For more complete information write to Edwin L. Wiegand Co., 7686 Thomas Blvd., Pittsburgh 8, Pa., or use Reader Service Card.

E—1049. Barrel Tumbling—Barrel tumbling times can be cut in half or concentrations of cleaner can be reduced by half with the new spray wash cleaner, recently introduced, by the Van Straaten Chemical Company, 546P W. Washington Blvd., Chicago, Ill.

While the new compound which does not etch or discolor was designed for spray washing of aluminum and aluminum alloys, later field research engineering has shown that the alkali cleaner is also twice as effective as existing compounds used in tumbling operations. The unique cleaner is not toxic or inflammable, cleans thoroughly and quickly and prevents rusting of ferrous parts.

In one plant test because of the extremely fast cutting and excellent lubrication provided by Vantrol 5341-A processing time was cut in half and shiny parts came out with no burrs. In another plant it was possible to cut the amount of compound used from 22 pounds to 7.5 pounds. For more information on this material use Reader Service Card.

E—1050. Industrial Skin Cream Dispenser—A special dispenser designed to fit jars of "Fend", barrier creams widely used to protect plant and factory workers against industrial dermatitis, is announced by Mine Safety Applicances Company, Braddock St., Pittsburgh 8, Pa.

By depressing the plunger in the cap, a small amount of Fend cream is dispensed, the MSA announcement explains. The dispensing unit is suitable for all this line of protective creams except "Fend I". Full details on the creams and dispenser are available. Use Reader Service Card.

E—1051. Electro Polarizer, Portable Galvanometer—Chemical analysis of plating solutions now can be analyzed with a great degree of accuracy and speed by means of an electropolarizer and a portable galvanometer, according to the

Too Strong — if it was dumped untreated into a stream or municipal sewage system. Toxic cyanide wastes can be completely oxidized and destroyed at controlled pH values by the widely used alkaline chlorination process.

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Equipment and Supplies

Patwin Instruments Co., and the General Electric Company, suppliers of the equipment.

The new Patwin electropolarizer utilizes the polarographic method of analysis, which chemists estimate saves half the the time formerly consumed by the chemical method. Most plating solutions, including copper cyanide, zinc cyanide, cadmium, brass, and nickel can be analyzed with the equipment.

Patwin records show that routine analysis of copper cyanide solutions which formerly took an hour now can be done in fifteen to twenty minutes and with a high degree of accuracy.

Use of the recently announced General Electric high-sensitivity portable galvanometer instead of a built-in galvanometer makes possible a standard case for the instrument. This and other innovations allow a reduced cost over conventional polarographic instruments. For more information on this equipment use Reader Service Card.

E—1052. Flexible Grinding Wheel—An entirely new principle for light grinding and metal finishing is being introduced by Merit Products, Inc., 4023P Irving Place, Culver City, Calif. The new tool,

known as Grind-O-Flex, is a flexible grinding wheel which consists of hundreds of individual abrasive cloth leaves sealed to a hard core. As the wheel rotates it presents a continuous abrasive surface to metal parts. It is designed to smooth surfaces and remove flaws from contours without the danger of digging into the stock, which occurs when using hard grinding wheels, drums, belts, etc.

Grind-O-Flex is extremely simple to set up and operate. A mounting arbor is provided for attaching the wheel to any standard plain or threaded shaft or for chucking in ¼ or ⅛ inch chucks. No special setup or equipment is necessary. Full information may be obtained by writing the manufacturers or by using Reader Service Card.

E—1053. Surface Finishing Machine—A new, double-roll surface finishing machine, designated as Model 202-A, has been introduced by Clair Manufacturing Company. It was designed for any degree of finish—from flash removal to mirror finish.

With its two-directional, electro-hydraulic feed mechanism, this machine features a straight line actuation principle, which is said to eliminate all rapidly wearing parts such as cams, gears, worms, levers, ratchets.

The machine was developed through the cooperation of several producers of cutlery and hand tools, and is recommended by the manufacturer particularly for faces of either open end or adjustable wrenches, wrench handles, wood chisels or cold chisels, cutlery blades and handles, and surgical instruments.

For additional details on the Model 202-A, write the manufacturer, 1016 S. Union Street, Olean, N. Y., or use Reader Service Card.

E—1054. Barrel Tumbler—Development of a new line of deburring equipment is announced by the White-Roth Machine Corp., Lorain, Ohio. Known as the Burr-Master, this new barrel tumbler removes welding slag, flame cutting slag, burrs and rust from weldments and machined parts. Actual time study records show that the majority of items processed can be deburred in one third the time necessary to process by hand. Removal of welding and flame cutting slag, on most items, is accomplished in one tenth the time.

The new BurrMaster with variable speed drive can be set at any desired barrel rpm from 5 to 30. Push button control makes it easy to position barrel door for convenient unloading and draining. The self-locking drive prevents the barrel from moving during loading or unloading. An electric timer leaves the operator free during deburring cycle and automatically shuts off the equipment when the cycle is completed. Complete details on the new tumblers may be obtained by using Reader Service Card.

E—1055. Unitized Vapor Degreaser—A revolutionary new unitized method of vapor degreasing for cleaning industrial parts and materials has recently been introduced by Baron Industries, 241P West Avenue, Los Angeles 31, Calif.

Combining the very latest methods of vapor degreasing with modern and scientifically perfected equipment, the new Baronet degreaser is both practical and economical in industrial cleaning operations.

Rapid parts cleaning is accomplished automatically in trichlorethylene vapors. Baronet economy degreasers require only five gallons of cleaning solvent for effective operation. For further information use Reader Service Card.

E—1056. New Lead Plate-Type Heater—A new lead plate-type heater for low pressure steam work in the chemical and process industries has been announced by Knapp Mills Inc., 23-17 Borden Ave., Long Island City 1, N. Y.

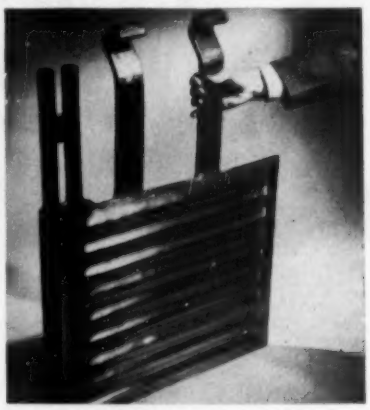

Plate-type heaters are compact, strong, relatively light in weight, and provide the largest practical square footage of heating area in the smallest space.

Recommended for use with 10 lbs of steam or less, the heaters come in three standard sizes. Special units to adapt the heater to unusual working conditions will also be designed. For additional data on this equipment use Reader Service Card.

E—1057. Self-Adhesive Aisle Markers—Economy and simplicity of installation plus extra safety advantages, are features of the self-adhesive aisle markers manufactured by W. H. Brady Company, 727P West Glendale Avenue, Milwaukee 12, Wis.

Markers are made of durable, colorful plastic, backed with a heavy duty, pressure-sensitive adhesive. They offer the maximum visibility that only a dotted line can provide, and are stocked in four bright colors, caution yellow, fire red, safety green and neutral white—sharp, vivid colors that command attention even in poorly lighted areas.

Besides costing far less to buy than paint, molded markers or tape, the markers are economical to apply. For more information and free samples, write to the manufacturer or use Reader Service Card.

E—1058. Copper Dip—Passivation of copper and most copper alloys is now available in a simple chemical dip and rinse process marketed by Rossaul Co., 170P Fifth Ave., New York 10, N. Y.

Standard bright dips such as nitric and sulfuric and various chromate dips, remove oxides quickly but reoxidation begins minutes after the original immersion.

Rossaul Copper-Brite removes atmospheric oxides in "seconds to minutes" and simultaneously passivates the metal so

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Many plants claim they save the entire cost of CONE-LOC DRUM SANDERS on the first 50 yards of abrasive used!

When the arbor nut is tightened down against locking cone the wheel becomes a perfectly balanced, smooth running drum . . . with no bounce at the joint. Can be re-headed with new abrasive strip in seconds.

Can be used on either flexible shaft or stationary arbor.

- **SAFE** *at speeds up to 4000 R.P.M. (6¼" diameter)*
- **PRECISION BALANCED** *at operating speeds*
- **LIGHT WEIGHT** *Now made of new "high tensile" aluminum alloy.*

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Diam.	Widths	Net. Wt. Lbs.	Delivered Price
6¼"	1"	1½	$24.75
6¼"	1½"	2	27.25
6¼"	2"	2¼	29.00
8 "	2"	3½	40.00
10 "	2"	6	48.00
12 "	2"	7½	58.50

Standard FELT CUSHION Sizes

6¼"	1"	1¼	$21.00
6¼"	1½"	1¾	22.75
6¼"	2"	2	24.75

Specify arbor hole size—½" to 1¼"
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Equipment and Supplies

that it will resist oxidation without surface coating for periods ranging from three to six months, dependent on atmospheric conditions.

The material is completely safe to handle, is non-toxic, non-fuming, it requires no special ventilation, will not discolor silver solder and will not etch. Special drains are not required. For more information use Reader Service Card.

E—1059. Combination Washing Machine—Metalwash Machinery Corp. of Elizabeth, N. J. announces a new combination rotary drum and flat belt washing machine.

Designed to remove drawing compounds, cutting oils, grease, and shop dirt from metal parts, this combination machine has both a rotary drum and a flat belt conveyor.

Small parts that can be tumbled are washed, rinsed, and dried in the drum, while the tote boxes and larger parts are processed on the conveyor. For more information on this new equipment use Reader Service Card.

E—1060. Tougher, Faster-Cutting, Longer Lasting Abrasive Chips—Recently made available to users of the Roto-Finish processes, new Coruloy "T" chips are described by the manufacturers, 3707P Milham Rd., Kalamazoo, Mich., as being extremely fine grained, tougher and longer-wearing than any of the aluminum oxide chips previously offered.

The new chips are useful for fast-cutting operations of both ferrous and non-ferrous metal parts, particularly when it is necessary to remove a relatively large quantity of metal during a short processing cycle, and when deburring is the primary reason for processing. For more information on the Coruloy "T" chips use Reader Service Card.

E—1061. Dipping Basket—American Agile Corporation, P. O. Box 168P, Bedford, Ohio, announces the development of non-corrodible dipping baskets.

Of all welded design in Agilene® construction grade polyethylene, this development makes available a dipping basket with the same features of strength, light weight, and extreme chemical resistance which have already won wide acceptance of Agilene as a material of construction in the metal cleaning, plating, chemical and allied industries.

It is light in weight, unbreakable, and completely inert to chemical attack by acids, alkalis and other corrosive inorganic solutions up to 160° F. For more information on these baskets use Reader Service Card.

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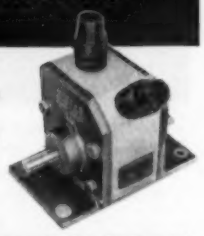

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CAPACITIES from fractional to 20 gpm . . . excellent for those hard to handle corrosive fluids and slurries. Illustrated booklet on request, as well as descriptive literature on corrosion resistant centrifugal pumps, valves, pipes and fittings.

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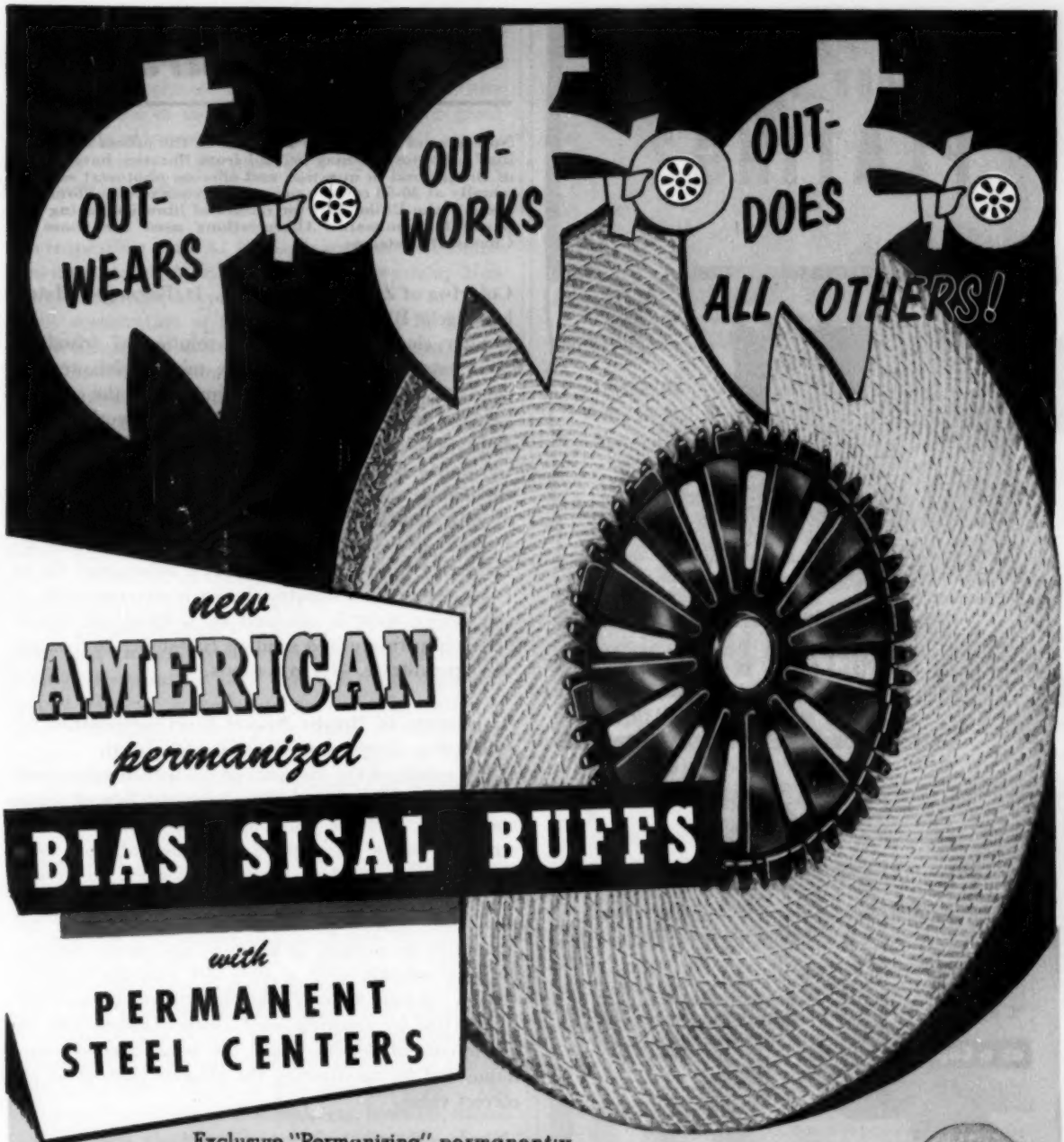

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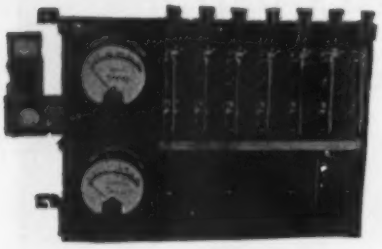

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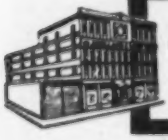

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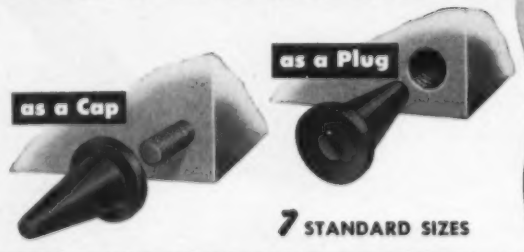

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Article Abstracts

No copies of articles are available at the offices of "Plating". Photostats may be had from libraries having files of the journal in question and offering photostat service, usually at 30-50 cents a page. Ask your public library to consult the Union List for names of libraries having the particular journal. Abbreviations used are those of Chemical Abstracts.

Coloring of Zinc Die Castings. H. Reininger, Metalloberfläche B76 (May, 1953).

After cleaning in a boiling solution of trisodium phosphate (5.5 oz/gal) for one minute, followed by thorough rinsing, the work is dipped into the coloring solution. After a cold and a hot rinse the work is dried and protected by a colorless cellulose lacquer.

A black color is obtained in a bath consisting of ammonium chloride (3.33 oz/gal), nickel chloride (5.05 oz/gal), ammonium thiocyanate (1.75 oz/gal), zinc chloride (0.4 oz/gal), at room temperature with an immersion time of up to 1 hour. A subsequent dip in 1 per cent sodium sulfate solution is recommended.

A brown color is obtained by a 10-second dip at room temperature in a solution containing 26.6 oz/gal of copper nitrate.—Otto Kardos.

Roughness in Bright Nickel Electrodeposits. C. J. Swanson, Trans. Inst. Finishing 29 (1953).

The results of the first part of the investigation indicated that solid, rounded nodules are formed upon conducting particles lying upon the surface, and at scratches in the basis metal. Rough-contoured, hollow nodules seemed to have been formed on irregularly-shaped nickel particles produced by faulty anode corrosion. Similar particles could be produced in the laboratory by working an anode at low current density or in a solution with a very low chloride content. Clearly, defects due to this cause could be avoided in practice by ensuring good anode contacts and an anode current density above the recommended minimum, and by maintaining the chloride content at its correct value.

"THERES NO TIME

like the present" to improve your knowledge of modern electroplating techniques. You can gain this knowledge easily and pleasantly through my unique home study course. Once gained you'll profit continuously from it. Write for the facts today. No obligation. Joseph B. Kushner, Electroplating School, 115 Broad St., Stroudsburg 10P, Pa.

In the second part of the work it was found that additions of electronegative colloidal carbon gave rise to extensive roughness. Metallic and oxide impurities caused nodules in most cases but particles of green nickel oxide entrapped in the deposit did not always affect the surface of the plate even when the particles were comparatively large.

Electroplating and A. E. S. Research. W. Blum. Presented at the A. E. S. Federal Convention, Melbourne, Australia, May 1953.

The organization of the work of the A. E. S. Research Committee is described. The researches thus far conducted are summarized. More details are given of some of the recent or current researches, including Projects 6 and 13 on Porosity, 9 on Properties of Nickel, 10 on Plating Room Wastes, 12 on Cleaning of Metals, 14 on Influence of the Basis Metal and 15 on Accelerated Tests.

Some Experience in Alloy Plating. B. W. Armstrong. Presented at the A. E. S. Federal Convention, Melbourne, Australia, May 1953.

The general principles governing the deposition of alloys and the effects of variables, such as current density, temperature and agitation, are discussed. Special reference is made to experiences in plating of alloys, including bronze, white brass, nickel-tin and lead-tin. Properties of these alloy deposits are reviewed and a description of salt spray and exposure tests is included.

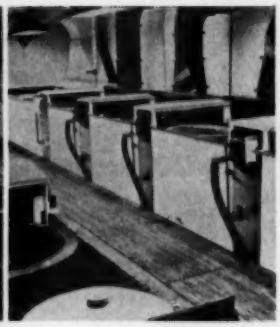
Values And Limitations of Plating Analysis. B. Johnson. Presented at the A. E. S. Federal Convention, Melbourne, Australia, May 1953.

Consistent achievement of high quality plating needs adequate control of all possible variables. The obvious starting point is by chemical analysis, but it must be appreciated that some addition agents and many forms of contamination cannot be determined economically by analysis, and we have to revert to practical plating tests allied with experience and common-sense. The vast scope for trouble in electroplating, however, means that any fault which may be anticipated readily, should be corrected before we are forced to descend to "trial and error" remedies. This is the true field for chemical analysis: to locate faults in composition of a solution, preferably before the results become obvious as an unsatisfactory deposit, and to narrow the field of subsequent enquiry.

The Use of Diamond Abrasives for a Universal System of Metallographic Polishing. L. E. Samuels. J. Inst. Metals 81, 471 (1953).

An investigation has been carried out to determine the most efficient and economical methods of using diamond abrasives for metallographic polishing. It has been found that the abrasive is most efficiently used when dispersed in a carrier paste, the polishing

BEFORE—*Stainless steel chemical installation after 14 months' service handling corrosive acids.*



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Typical Van-Cor pipes and fittings fabricated to specifications by Van Dorn.

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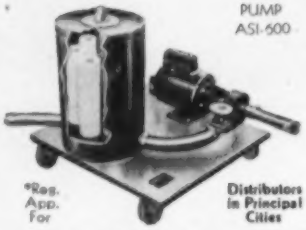

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ASI-400	400 gal/hr	2' x 2' x 2'	135 lb
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Article Abstracts

rate then being 4–5 times that of dry application, and that it can be used economically only in the finer grades (0–10 micron particle-size range). The polishing rates are then extremely high; even with hand polishing, the rates are frequently higher than that of electrolytic polishing.

The results of the work are applied to the development of a system of metallographic polishing, the costs of abrasive for which are sufficiently low to permit its use for general, and even routine, polishing. To bridge the gap over which diamond abrasives cannot be used economically, a cast wax-abrasive lap has been developed, the characteristics of which are such as utilize the full potential of the subsequent diamond stages. Consideration has also been given to final polishing treatments necessary to give truly scratch-free surfaces. The system finally developed is very rapid and produces a polish of very high quality, with a surface free from objectionable deformation.

Electrodeposition Research. Proceedings of the NBS Semicentennial Symposium on Electrodeposition Research held at the NBS on December 4–6, 1951, National Bureau of Standards Circular 529, 129 pages, 38 figures, 19 tables, buckram bound, $1.50. (Order from Government Printing Office, Washington 25, D. C.)

Electrodeposition processes have become an integral and important part of many industries—for example, the printing, metal refining, extractive metallurgy, hardware, automobile, and electronic industries. This has come about largely as a result of extensive research in the field of electrodeposition, especially during the past 25 years. This volume contains the papers given at a symposium sponsored by NBS to encourage further research in this field, to present current research results and problems, and to facilitate the exchange of information.

Representing a cross section of research currently being conducted in electrodeposition by industrial, uni-

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The three ACME Semi-Automatics above are from left to right, the ACME A-2, a 2 spindle hand indexing machine for polishing and buffing cylindrical parts up to 12" diameter . . . the ACME L-4, a 4 spindle automatic indexing machine with a normal range of 250 to 400 indexes per hour . . . and the ACME D-10, an oscillating machine for finishing out of round parts. These machines are proved producers.

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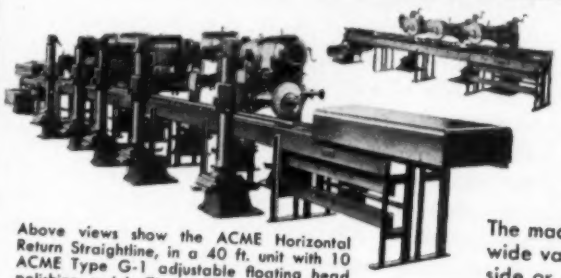

Above views show the ACME Horizontal Return Straightline, in a 40 ft. unit with 10 ACME Type G-1 adjustable floating head polishing and buffing lathes . . . and a 20 ft. unit with 3 ACME Type G-3 lathes.

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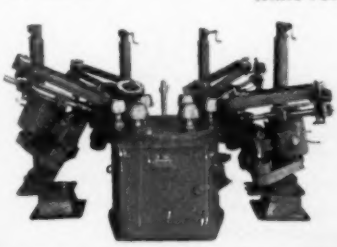

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PROBLEM:

To remove stamping oils and shop dirt from radio chassis in a conveyorized sequence of operations which was arranged for vapor degreasing and electrocleaning.

Former Process: Prior to a cyanide copper strike, the chassis were cleaned in a vapor degreaser, a 10-12 ounce per gallon electrocleaner, a 50% muriatic acid pickle and appropriate rinses.

Present Process: Includes a 3-minute immersion in 6 ounces Diversey No. 909 per gallon, a 1-minute reverse current electroclean in a 10 ounce per gallon solution of Diversey No. 12, a rinse, a 50% muriatic acid pickle, a rinse and a copper strike.

Results: At the time this problem was presented to the D-Man, the firm having the job was ready to cancel it. Their process was incapable of producing a sufficiently clean surface for acceptable adherence of the electro-deposit. The first step toward a solution of this problem was to replace the electrocleaner with Diversey No. 12—*and this solved the problem!* Diversey No. 12 removed all contaminant residues remaining after the degreasing operation and produced a surface to which, when pickled, electrodeposits adhered perfectly. Diversey No. 909 replaced the vapor degreaser because of its ability to remove even solid particle contamination and its capacity for contamination. The soak tank and the electrocleaner are of 2400 and 2000 gallons respectively, yet only 250 pounds Diversey No. 909 and 150 pounds Diversey No. 12 are added weekly for upkeep in this high production line!

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versity, and government laboratories in Europe and the United States, the papers cover such topics as research on electrodeposition in Great Britain, the United States, France, Germany, Belgium, and Holland; electrodeposition research at Battelle Memorial Institute, United Chromium, Inc., the Bureau of Mines, Armour Research Foundation, Westinghouse Electric Corporation, and Sylvania Electric Products; research at Enthone, Inc., on metal finishing; brass plating; electroplating in the sleeve-bearing industry; corrosion resistance of copper, nickel and chromium-plated zinc, aluminum and magnesium base die-castings; determination of impurities in electroplating baths; effects of impurities in plating solutions; porosity in deposits; correlation of gas permeability of electrodeposits with their weathering behavior; properties of electrodeposited nickel; disposal of cyanide wastes from plating operations; current and metal distribution in electrodeposition; and a new degreasing evaluation test: the atomizer test.

Current Supply and Electric Hazards. J. Della-Pietra. Presented at the A. E. S. Federal Convention, Melbourne, Australia, May 1953.

The flow of an electric current through a conductor is essentially a movement of electrons. Because of the resistance of the conductor, a voltage drop occurs. If the conductor is inadequate, a serious rise in temperature occurs and the resistance rises, causing a further loss of voltage. A fraction of a volt lost in a low voltage electroplating system is far more serious and costly than a fraction of a volt lost, say, in a 230 volt household supply. It is essential, therefore, to have conductors of adequate cross sectional area and to have flat or square conductors where joining is necessary. Surfaces for joining must have an area more than the cross section of the conductors. All joint surfaces should be well tinned, and, after joining, should be heavily lacquered to prevent corrosion. Low voltage, high current conductors should be well protected, for although the voltage is not lethal, a spanner or similar

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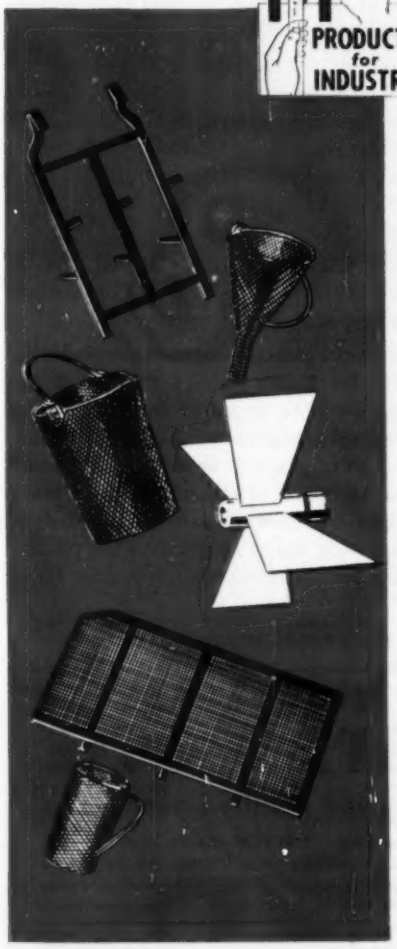

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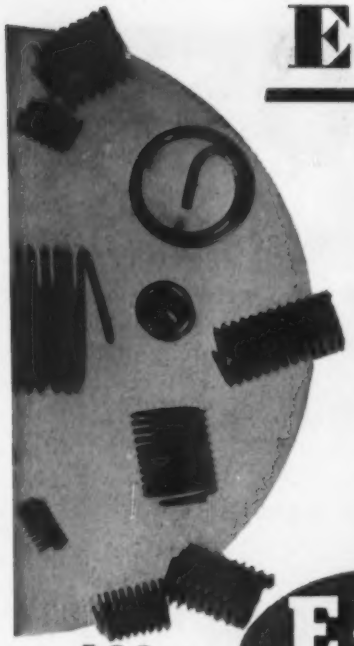

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Article Abstracts

article dropped across unprotected conductors can create a very dangerous situation.

Abrasive Belt Polishing. A. E. Fowler. Presented at the A. E. S. Federal Convention, Melbourne, Australia, May 1953.

A brief outline is given of the construction of coated abrasive belts and the advantages arising from this type of grinding and polishing medium as eompared with set-up wheels. Belt equipment and machines in use at the present time are described and their limitations discussed. A wider application of this method is expected as a result of new methods and machines being developed overseas. Details are given of local research along the lines of overseas development to cope with Australian problems.

Latest Trends in Electroplating Practice. W. Blum. Presented at the A. E. S. Federal Convention, Melbourne, Australia, May 1953.

A film on the plating of automobile bumpers and one on the plating of zinc die castings is shown. Some colored sides showing the diverse activities of the National Bureau of Standards are exhibited. A brief summary of the present status of plating in U. S. A. is presented.

Bath Purification With Activated Carbon. W. J. Blanch. Presented at the A. E. S. Federal Convention, Melbourne, Australia, May 1953.

Introduction of bright plating processes coupled with industry's demand for better quality control of deposits, have emphasized the necessity for maintaining solutions at a high level of efficiency. Activated carbon is playing a large part in this direction. Practically all solutions, with the exception of chromium baths, react favorably to carbon treatment. Activated carbon is most effective when thoroughly mixed with the plating solution at elevated temperatures via the storage tank.

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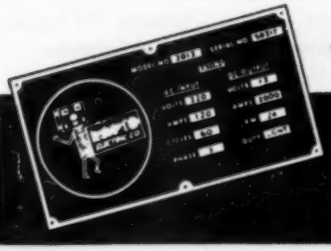

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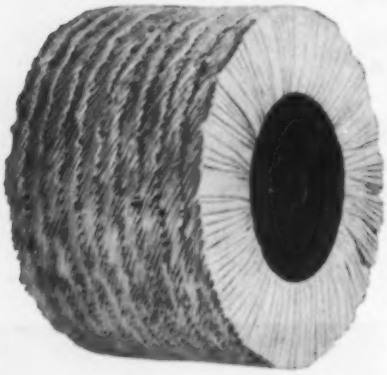

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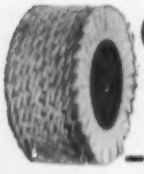

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Article Abstracts

It should never be added directly to the plating tank. The type of carbon is important and recommendations together with procedure for its use in the various solutions are listed.

New Methods of Plating Control. R. D. Taylor. Presented at the A. E. S. Federal Convention, Melbourne, Australia, May 1953.

Careful observation and resultant additions to solutions or modification of plating conditions, based on sound experience, have served the plater well as methods of plating control. However, the development and wide-spread use of chemical tests for controlling bath composition and physical tests for controlling and assessing final deposit properties have contributed much to the raising of plating standards. Recent developments in this field are summarized including thickness, adhesion, porosity and stress tests with special reference to a porosity test for electrodeposits on zinc base die castings developed at D. R. L. (Melbourne) and a critical treatment of the control of organic impurities in nickel baths.

Plant Engineering. C. J. Cocks. Presented at the A. E. S. Federal Convention, Melbourne, Australia, May 1953.

Proper engineering is vital to successful plant installation and maintenance, and also plays an important part in subsequent production. A wide variety of problems confronts the man in charge. This paper covers the salient features in engineering a plating plant, such as design, construction, layout, installation and maintenance. Reference is also made to some of the economic considerations in selection of plant. Special emphasis has been placed on two points, namely, ventilation and steam heating. A new concept of lateral tank ventilation has proved outstandingly successful in practice. Considerable savings can be made in the operation of the plant if efficient use is made of all steam generated.

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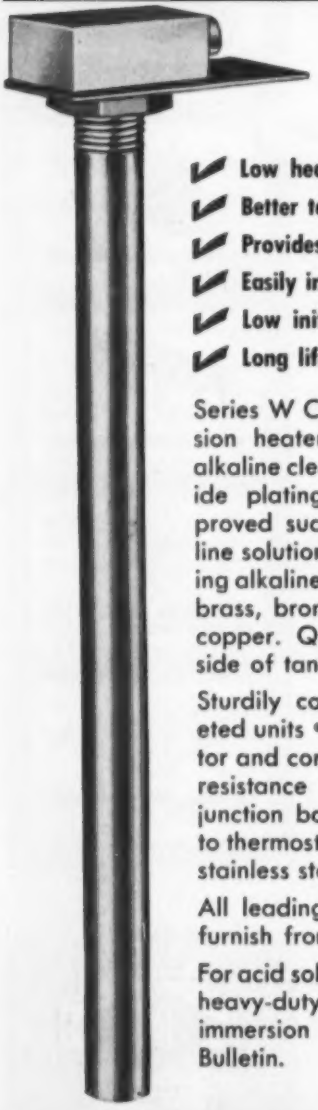

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Patent Abstracts

GEORGE B. HOGBBOOM
Consultant, New Britain, Conn.

Copies of patents may be obtained by writing to Commissioner of Patents, Washington, D. C. Price 25 cents each.

No. 2,644,789, July 7, 1953—Electrodeposition of Nickel. W. J. Shenk, Jr., assignor to The Harshaw Chemical Company.

CLAIM 6. A method of electrodepositing nickel in the form of a deposit which is bright as taken from the solution without further treatment and which comprises electrolyzing and aqueous, acid solution of a nickel electrolyte of the class consisting of nickel sulfate, nickel chloride and mixtures of nickel sulfate with nickel chloride, said solution also containing cooperating addition agents capable of imparting brightness to the deposit, one of said addition agents being oxydiethylene-bis-iso-quinolinium chloride, and the other said addition agents being sulfonated naphthalene said first mentioned addition agent being present in concentration from 0.005 to 0.01 gram per liter, and second mentioned agent being present in concentration from 0.2 to 15 grams per liter.

CLAIM 7. The invention as defined in claim 6 further characterized in that there is included as a third addition agent, 2,5-dichloro-dibenzenesulfonamide in quantity such that the combined concentrations of the sulfonated naphthalene and 2,5-dichloro-dibenzenesulfonamide are within the range of from 0.2 to 15 grams per liter.

7 claims.

References cited: U. S. Patents 2,513,280; 2,550,449.

Notes on U. S. Patents: In legend, 12 compounds of pyridinium are given as an example of the addition agents that can be used, a table of 8 compositions of a solution is given in which are included nickel sulfate, nickel chloride and nickel fluoborate, the temperature, *p*H, current density in amperes per square foot and anti-pitting agents e.q. sodium lauryl sulfate. *2,644,789:* in the legend there are 3 group arrangements so as to classify the addition agents i.e., Group 1—alkylene-ether type linkage; group 2—alkylene linkage; group 3—alkylene aromatic linkage.

Twenty carriers or regulators are listed. In claim 5 twenty-three (23) cooperating agents capable of imparting brightness to the deposit are named and also "other of said addition agents being a cyclic organic compound of the class consisting of 24 of such compounds". A comprehensive composition of 17 solutions which contain the amount of each addition agent named in the invention:

"The preferred basic solution in which the invention is realized", viz: all sulfate; all chloride; and sulfate-chloride (Watts' type) is given.

No. 2,645,611, July 14, 1953—Method and Bath for Electrolytic Polishing. U. G. Axtell, assignor to Shwayder Bros., Inc., Denver, Colo.

Because of the interest in the polishing of stainless steel, and the disclosure of perchloric acid as the principal constituent of the electrolyte, a large amount of work and a considerable number of electrolytes involving perchloric acid were developed. However, perchloric acid is an extremely critical material to handle and there have been several instances in which loss of life has been occasioned by explosions in plants using perchloric acid for electrolytic polishing purposes.

Among the objects of the present invention are to provide a novel electrolyte or bath and method of electrolytically polishing articles of brass and certain other metals and alloys; to provide such a bath and method which can be used in polishing curved and irregular surfaces . . . to provide such an electrolyte which has a relatively long life . . . which does not produce noxious or dangerous fumes . . . which will operate successfully over a relatively wide range of temperature . . . and to provide such a method by which polishing results can be duplicated with regularity and is therefore applicable to mass production.

CLAIM 1. An electrolytic polishing bath comprising by volume, from approximately 35 per cent to approximately 70 per cent orthophosphoric acid; from approximately 8 per cent to 64 per cent of at least one water soluble polyhydric alcohol; from approximately 1 per cent to approximately 12 per cent of a monohydroxy mono-carboxylic acid; from approximately 5 per cent to approximately 30 per cent of water; and from 0 to approximately 10 per cent of an addition agent adapted to increase the brightness of an article polished in said bath, the total of said constituents being approximately 100 per cent.

Note:—solution composition in legend:

	Proportion per cent
Orthophosphoric acid	35–70
Polyhydric alcohol	8–64
Lactic acid or substitute	1–12
Water (including water in acid)	5.30
Addition agent (monosodium glutamate)	0–10

18 claims, 10 figures.

References cited: U. S. Patents 2,015,304; 2,348,517; 2,386,078; 2,411,410. Canadian Patent 449,619. Transactions Electrochemical Society, Vol. 78 (1940), pp. 265–279. Metal Industry (1940), pp. 22–23.

No. 2,645,635, July 14, 1953—Method of Regenerating Electrolytic Polishing Solutions. Harold Walton, assignor to Shwayder Bros., Inc., Denver, Colo.

24 claims.

Two preferred solutions or baths for electrolytic polishing of brass, the difference between the two residing primarily in the addition agent, may have the following approximate proportions by volume.

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- ¶ How to prepare metal for painting. *See page 9.*
- ¶ Tips on selection and operation of washing machines. *See pages 10 to 12.*
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Constituent	*Proportion per cent*
Orthophosphoric acid 85 per cent	41.5
Glycerol	24.9
Ethylene glycol	16.6
Lactic acid	8.3
Water	8.7
Orthophosphoric acid	39.8
Glycerol	23.9
Ethylene glycol	15.9
Lactic acid	8.0
Monosodium glutamute	4.0
Water	8.4

CLAIM 23. A method of regenerating an electrolytic polishing solution initially containing phosphoric acid and water which solution has been utilized in electrolytically polishing brass, such method comprising adding to said solution a reagent selected from the group which consists of oxalic acid, calcium oxalate, barium oxalate, methyl oxalate, ethyl oxalate, glycol oxalate, and glyceryl oxalate, said reagent being added in an amount sufficient to precipitate at least a portion of the dissolved copper and zinc and less than the amount which will result in free oxalic acid being present in the solution when utilized again.

References cited: U. S. Patent 2,294,227. British Patent 618,120. Hackh's Chemical Dictionary, 2nd edition (1937), p. 1017.

No. 2,646,396, July 21, 1953—Method of Making Electroformed Articles—Reginald S. Dean, Washington, D. C.

EXAMPLE 1. I take a sheet of ductile titanium and prepare the surface by cleaning with a 10 per cent solution of hydrofluoric acid. I then polish the surface with the finest emery and rouge and then clean thoroughly in an alkaline cleaner, followed by 2 per cent sulfuric acid. The clean surface is allowed to dry in air for 15 minutes to insure passivation. I then plate this surface with copper from a slightly acid solution of copper sulfate to a thickness of 0.0005 of an inch. This thin copper sheet is readily separated from the

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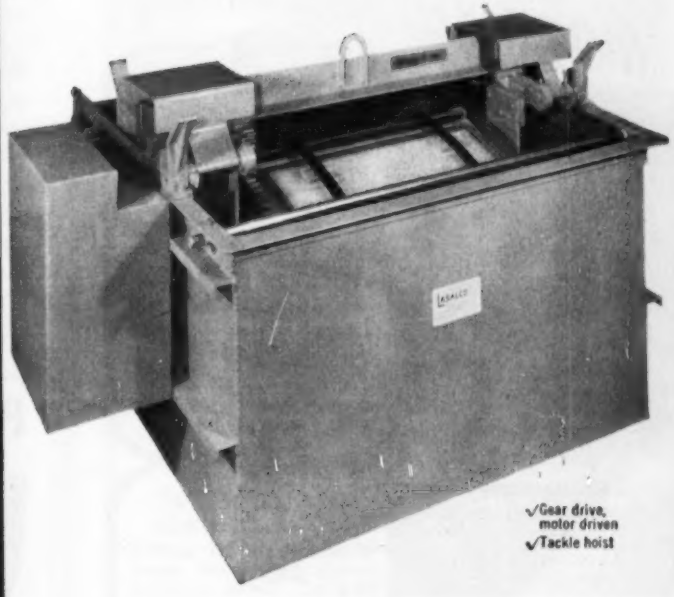

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Patent Abstracts

titanium and is smooth, bright and clean and ready for many uses in the arts. The titanium cathode base is re-used without further treatment for the preparation of several hundred such copper sheets.

CLAIM 1. The cyclical process of electrolytically depositing a metal on a cathode surface selected from the group consisting of titanium and zirconium of at least 90 per cent purity, which comprises initially preparing the cathode surface by cleaning and washing the same and passivating by exposure to air, and thereafter at least once executing the sequence of steps consisting in depositing said metal from an aqueous solution of a salt thereof onto said cathode surface, removing the cathode and its attached deposit from the electrolyte, mechanically stripping the deposit from the cathode surface, exposing the cathode to air and replacing the cathode in said solution, and then at least once repeating said sequence of steps.

CLAIM 2. The cyclical process defined in claim 1 in which the cathode is titanium.

CLAIM 3. The cyclical process defined in claim 1 in which the cathode surface is titanium, and the electrodeposited metal is manganese.

4 claims, 8 examples.

References cited: U. S. Patents 1,709,268; 1,861,625; 2,203,253; 2,227,454; 2,279,567; 2,292,026; 2,325,660; 2,433,441; 2,529,086. British Patent 436,282. PLATING January, 1948, pp. 39–42 and 45. Transactions, American Institute of Mining and Metallurgical Engineers, Vol. 166 (1946), pp. 379–381.

No. 2,646,397, July 21, 1953—Electroplating Zinc Using Titanium Containing Electrolyte—Raymond J. Wean, assignor to The Wean Engineering Co., Inc., Warren, Ohio.

. . . Incorporation of titanium in the electrolyte has all the advantages without any of the disadvantages of the use of organic addition agents which break down during the electroplating process. By incorporating titanium in the electrolyte, I obtain with uniformity a desirable bright lustrous finish. I can

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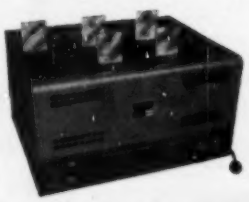

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with comparative ease maintain the electrolyte uniform. I can obtain with uniformity a desirable bright and lustrous and desirably ductile coating at higher speed than the highest speed at which results inferior to my results have heretofore obtained. I provide a new product consisting of basis metal, especially ferrous metal electroplated with zinc in which the plating contains titanium.

I also obtain an unprecedented levelling effect on the surface of my work. The surface of my plated work is more level than the surface of the basis metal before plating.

CLAIM 11. A method of electroplating zinc on a basis metal comprising passing an electroplating current from an anode to the basis metal as a cathode through an electrolyte containing about the quantities below indicated of the ingredients listed.

	oz./gallon
Zinc sulfate	48.0
Ammonium chloride	4.0
Sodium acetate	2.0
Dextrose	16.0
Concentrated sulfuric acid	1.5
15 per cent water solution titanous chloride	0.8
30 per cent water solution hydrogen peroxide	0.25

at a current density of at least 100 amperes per square foot.

11 claims.

References cited: U. S. Patents 1,491,381; 2,233,500.

No. 2,647,864, August 4, 1953—Etching Process, Daniel Goffredo, Easton, Pa.

The invention will be more particularly described with reference to a bimetallic plate of copper on zinc. The image to be reproduced is projected upon a light-sensitive acid resistant coating on the copper surface, and the non-exposed portions of the coating are removed in the conventional manner. . . . The removal of the copper from the exposed areas may be accomplished by electrolytic or chemical methods. . . . The plate is then ready to be etched with a copper sulfate solution which may be variously modified with oxidiz-

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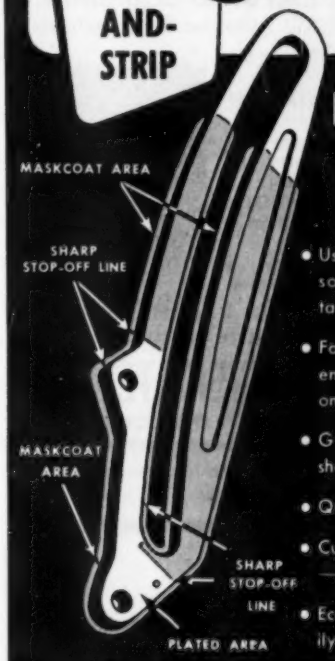

Here's how
MASKCOAT No. 2
cuts cost—saves time—speeds production

- Use in all common plating solutions—will not contaminate bath.
- Fast 2-second dip—hardens in 60 seconds—only one coat needed.
- Good adhesion—gives sharp hairline stop-off.
- Quick, easy precision trim.
- Cuts reject costs to minimum—fewer re-runs.
- Economical—strips off easily for remelting and re-use.

Cuts plating costs on F85 Saber Jet part

- Easy-dipping process does not require trained or skilled help.

Learn why MASKCOAT is the best "all-around" stop-off. How it helps speed your plating production and cut costs. Send today for MASKCOAT facts.

WESTERN COATING COMPANY

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Western Plant—85 West Union Street, Pasadena 1, California
Representatives in principal cities

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SEND ME LITERATURE ON WESTERN COATING PRODUCTS.

NAME & COMPANY_____

ADDRESS_____

CITY_____ ZONE_____ STATE_____

NOW YOU CAN GET THE
NEW TYPE VITREOSIL*
(pure fused silica)
ELECTRIC IMMERSION HEATERS

Here is the latest improvement in immersion heaters for heating acid pickling and electro-plating solutions, and other acid baths.
This new VITREOSIL immersion heater features:

- Increased heat transfer per unit area
- Greater resistance to chemical attack
- Molded rubber cap providing efficient sealing and facilitating installation.
- Ground wire inside VITREOSIL sheath for additional electrical protection
- Minimum safe immersion depth marked on each heater

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THE THERMAL SYNDICATE, LTD.
14 BIXLEY HEATH LYNBROOK, N. Y.

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Seeley Compounds

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offer a choice of the
Right Type
For All Metal Finishing

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Burring — Polishing — Buffing

—

E. E. SEELEY COMPANY, INC.
Bridgeport, 1, Conn.

ers, abrasives and other additives. . . . The copper sulfate solution is applied to the plate by means of an aspirating air blast.

The following are formulas of suitable etchants for copper plated zinc plates:

$CuSO_4.5H_2O$		300 grams
Oxidizer	Nitric acid cp.	10 cc
Additive	Aerosol O T–	10 cc
	Sodium carboxymethyl cellulose	10 grams
Abrasive	Clay suspended in the solution	10 grams

CLAIM 5. A method of making etched plates comprising forming a resist image on a copper-plated zinc plate, removing the copper under the non-resistant portions of the plate and then etching the exposed portions of the plate to produce a relief image by an air-blast etch with a solution of copper sulfate containing nitric acid, suspended clay, and a wetting agent, whereby copper is deposited from the etching solution and adheres to the edges of the etched pits and protects them from undercutting.

5 claims, 8 examples.

References cited: U. S. Patents 2,558,504; 2,584,317

No. 2,647,865, August 4, 1953—Brightening Aluminum and Aluminum Alloy Surfaces—Herbert W. Freud, dit Jean Frasch, Nanterre, France.

CLAIM 1. The process of producing a permanently highly reflective surface on articles formed of aluminum and aluminum alloys comprising the steps of degreasing the article; washing the degreased article; immersing the article in a highly acid aqueous bath essentially consisting of 30 per cent to 35 per cent phosphoric acid and 10 per cent to 15 per cent chromic acid so as to clean the article by removing alumina therefrom without attacking the aluminum metal, thereby producing a satin-like surface on the washed article; electrolyzing the satin-like article in an aqueous alkaline bath consisting essentially of an alkali metal phosphate and an alkali metal aluminate in an amount such that said bath contains between 2 per cent to 10 per cent phosphate ions and between 0.5 per cent to 5 per cent aluminate ions so as to produce a thin coating of aluminum hydroxide on a surface of the article, thereby brightening the same, the aluminum article being the anode in the electrolytic cell; washing the thus coated article; subjecting the thus coated article to a highly acid aqueous bath essentially consisting of phosphoric acid and chromic acid so as to dissolve the alumina on the surface of the article, thereby further and evenly brightening the coated surface of the aluminum article; and washing the thus treated article so as to recover the final permanently aluminum article.

9 claims, 3 examples.

References cited: U. S. Patents 2,008,733; 2,096,309; 2,153,060; 2,353,786. British Patent 558,925. German Patent 688,668.

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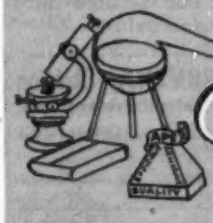
JUST OUR WAY
of saying "Hello" and "Thanks".

"Hello" to those of you who know us and our products, and . . .
"Thanks" to those of you who have in the past or may in the future work with us on cleaning problems in the plating field.
In our 20 years of doing business, SERVICE has been foremost in our minds. Your confidence in us enables us to improve it a little all the time.

At Your Service ANY TIME!



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A COMPLETE LINE OF CLEANING COMPOUNDS FOR THE PLATING INDUSTRY

MAIN AND RECTOR STREETS, PHILADELPHIA 27, PENNA., Phone, IVyridge 3-3939

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THE FOLLOWING EXCELLENT REBUILT AND GUARANTEED ELECTROPLATING MOTOR GENERATOR SETS AND RECTIFIERS, WITH FULL CONTROL EQUIPMENT:

PLATERS

3—10,000/5000 AMPERE, 12/24 VOLT, **ELECTRIC PRODUCTS**, Synchronous.
1—7500/3750 AMPERE, 6/12 VOLT, **MUNNING** "OPTIMUS."
1—6000/3000 AMPERE, 6/12 VOLT, **BOGUE**, Synchronous.
1—5000/2500 AMPERE, 8/16 VOLT, **ELECTRIC PRODUCTS**, 25° C., Synchronous, Exciter-in-head.
1—5000/2500 AMPERE, 9/18 VOLT, **COLUMBIA**.
1—5000/2500 AMPERE, 7/14 VOLT, **CHANDEYSSON**, 25° C., Exciter-in-head.
1—5000/2500 AMPERE, 6/12 VOLT, **CHANDEYSSON**, 25° C., Synchronous, Exciter-in-head.
1—4000/2000 AMPERE, 6/12 VOLT, **CHANDEYSSON**, 25° C., Synchronous, Exciter-in-head.
1—3000/1500 AMPERE, 6/12 VOLT, **ELECTRIC PRODUCTS**, Synchronous, Exciter-in-head.
1—3000/1500 AMPERE, 6/12 VOLT, **COLUMBIA**, Synchronous.
1—2000/1000 AMPERE, 8/16 VOLT, **ELECTRIC PRODUCTS**.
1—2000/1000 AMPERE, 6/12 VOLT, **CHANDEYSSON**, Synchronous.
1—1500/750 AMPERE, 6/12 VOLT, **H-VW-M**, Synchronous, Exciter-in-head.

ANODIZERS

1—4000 AMPERE, 40 VOLT, **CHANDEYSSON**, Exciter-in-head.
1—1000 AMPERE, 30 VOLT, **IDEAL**, Exciter-in-head.
1—1000 AMPERE, 40 VOLT, **CHANDEYSSON**, 25°C.
1—500 AMPERE, 25 VOLT, **CHANDEYSSON**, Synchronous, Exciter-in-head.
1—400 AMPERE, 40 VOLT, **M. G. C.**, Exciter-in-head

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BRAND NEW BASIC RECTIFIERS, 1500/750 amperes, 6/12 volts. Special Price: $750.00 each. Separate Voltage Controls available.
1—2000 AMPERE, 6 VOLT, **G. E.** COPPER OXIDE, and Control.
1—**GREENS ELECTOPLATER**, 1800 AMPERE, 12 VOLT, 220/3/60.
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SPECIAL

1—**MERCIL** 12 x 12 CENTRIFUGAL DRYER, Electric Heat.
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4—24" and 30" **ROBBINS & MYERS** 2-SPEED VENTILATING FANS.
3—**NO. 1 HARTFORD TRIPLE-ACTION** BURNISHING BARRELS, Lined and Unlined, Belted.

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Kirkland 7-5460 **CAMBRIDGE 38, MASS.**

A. E. S. News

Convention Paper Deadline Extended

The Editorial Board is meeting this month in New England, primarily to plan for the educational sessions to be held in conjunction with the New York Convention. Members who may be considering preparing papers will be pleased to hear of the extension of the deadline date for receipt of manuscripts. The new date is April 15, 1954. However, in order to allow for wider pre-Convention discussion of the subject matter, a brief abstract or outline of the proposed paper should be sent into Headquarters along with a properly executed "Offer Form," by January 15, 1954. Copies of the Offer Form will be mailed to those writers requesting one.

A. E. S. Committee Appointments

Mr. Myron B. Diggin, Research Director, Hanson-Van Winkle-Munning Company, has been appointed to the Research Committee to complete the unexpired term of Mr. R. W. Oyler.

The following new appointment to the Law Committee has been made:

George W. Cavanaugh, General Electric Company, Syracuse, N. Y. Reappointed to this committee which is headed by Manson Glover, Glover Coating Company, Malden, Mass., were Myron B. Diggin, Hanson-Van Winkle-Munning Co., Matawan, N. J., and William J. Neill, Columbus Metal Products, Columbus, Ohio.

National Officers in the News

Executive Secretary P. Peter Kovatis and Past President F. J. MacStoker have been authorized by the Executive Board to attend the Louisville Branch A. E. S. meeting on November 19, 1953.

Dr. Samuel Heiman, Supreme Third Vice-President, presently is working on two Society projects, (a) the preparation of a Convention Manual which will contain detailed data on the operation of a convention, and (b) the preparation of a Branch Officer's Manual.

Sustaining Memberships

The Executive Board has found strong indications in favor of each A. E. S. Branch setting aside one meeting night a year as SUSTAINING MEMBERS' NIGHT. The Board wishes to suggest adoption by the branches of such an affair since such a step gives deserving recognition to those members and offers favorable stimulation for increased sustaining memberships.

STEEL EYELETS NICKEL-PLATED TO A THICKNESS OF .00015"

The nickel solution in which these eyelets were plated was analyzed with a Patwin C-1 Electro-Polarizer. With this low-priced instrument, analysis of plating solutions can be made rapidly and accurately in your own shop —at a considerable saving in cost.

The Patwin Model C-1 is specially designed for polarographic analysis of plating solutions. It will determine principal constituents and metallic impurities in solutions of brass, cadmium, chrome, nickel and the precious metals. For detailed information, mail coupon below.

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THE PATENT BUTTON COMPANY, Waterbury, Conn.

Please send me information on the Patwin C-1 Electro-Polarizer.

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Branch News

DALLAS-FORT WORTH BRANCH

A regular meeting of the Branch was held at the Lennox Hotel, Grand Prairie, Texas, on May 27. New officers for the coming year were in charge of this meeting. These officers are as follows:

President—MAURICE ZITO
First Vice-President—BOB MILLER
Second Vice-President—ANDY LARSON
Secretary-Treasurer—A. C. FRICKE
Librarian—R. H. HEPPEL
Sergeant-at-Arms—ROY THOMAS
Board of Managers—ROY THOMAS, JOHN O'NEAL, FRANK LANE

Speakers for this meeting were furnished by Minnesota Mining & Manufacturing Co. O. S. JUDD of the Dallas office gave a very interesting talk on abrasive belts, and presented a film made by his company on the use of abrasive belts. R. W. BOBDRAIN gave an interesting talk on electroplating tapes. JOHN COPPAGE gave a talk on abrasives. A question-and-answer section followed these talks.

R. H. HEPPEL, *Librarian*

DETROIT BRANCH

The Branch held the Annual Stag Day outing on July 18 at the Glen Oaks Country Club in Farmington, Mich. In spite of a rainy morning, over 900 members and guests were on hand, this being an all time attendance record. Since the entire facilities of the Country Club were reserved for the Stag Day guests exclusively for the entire day, the heavy turnout did not present any problem.

The planned activities which included breakfast, golf, archery, bait casting, pie eating and egg throwing contests, tug-of-war, and other events were carried out smoothly and participation and enthusiasm indicated that everyone enjoyed them thoroughly.

Door prizes were given to all and refreshments were available all day.

For the day's climax an excellent roast beef dinner was served at 6:00 P. M. complete with dinner music by strolling musicians.

The Stag Day Committee was headed by A. J. EMMERICH, General Chairman, who was assisted by WALTER PINNER, CLEVE NIXON, JOHN SIEFEN, GUY CUMMINGS, FRED WAGNER, WRIGHT WILSON, HERB HEAD, LES BORCHERT, FRANK CLIFTON, ED KUBIS and others.

E. J. KUBIS, *Publicity Chairman*

INDIANAPOLIS BRANCH

The first meeting of the 1953–1954 year was attended by 33 members and guests who enjoyed a steak dinner at the Fox Steak House on September 2. Guests included EZRA BLOUNT of Cincinnati, TOM O'BRIEN of Chicago and MARVIN STEUERNAGEL of Milwaukee.

ABRAHAM MAX, president, opened the meeting by asking each person present to introduce himself and state his business. This was followed by the secretary's report and the treasurer's report on the April dinner-dance, which noted a balance of $292.01 after all bills were paid.

National Convention reports were given by JOHN HOLLAND and JOHN HOOD.

The following were elected to become members of the society: JAMES D. POWELL, 258 S. Sheridan Street, Indianapolis, and EDWARD SMITH, R. No. 2, Elmwood, Ind.

Future plans were discussed concerning program and the annual dinner-dance. It was decided to eliminate the educational session at the next regular affair but to have the dinner and dance. Mr. Blount was present especially to talk about a regional meeting of the branches of Cincinnati, Louisville, Dayton, Columbus and Indianapolis. This idea was discussed widely by many. BARRY SMITH made a motion that the Indianapolis Branch support the Ohio Valley Regional convention. This was seconded by AL KRIESE and passed. This regional will no doubt attract very fine speakers for the educational session.

Mr. Holland reported that Columbus, Ind., is getting ready for the October meeting on the 7th. The dinner will be at the Arvin Cafeteria and the entertainment will be by nationally known stars.

The Branch meeting for November will be held at the Hotel Antlers in Indianapolis.

The question was raised by the national officers whether Indianapolis Branch has any sustaining memberships and there are at least two of these. MR. WEEKLY will check into this matter and let us know.

The speaker of the evening was CHARLES O. HARKIN of Metal Coatings and Mfg. Co. Mr. Harkin, a former school teacher, quoted many passages from letters of famous Indian pioneers and historians. He cited how many cities obtained their names and how some various streets got theirs.

The meeting adjourned at 9:50 P. M.

EDNA ROHRABAUGH, *Secretary*

MELBOURNE BRANCH

The 80th regular meeting of the Branch was held on August 20 at Melbourne Technical College, with PRESIDENT G. WALKER and 48 members and visitors present.

After general business was dispensed, the speaker of the evening was introduced by LIBRARIAN H. TEAGUE. MR. J. MEEHAN's subject, "Lathe Polishing and Colouring of Metals", was opened with an explanation of methods of grinding and polishing, care being taken on angle of operation and stance of operator. Various abrasives and their application to wheels were discussed. Samples of work finished with loose fold mops and satin compounds were exhibited, and interesting operation time figures were discussed.

An open discussion period followed and MR. GEORGE GOW thanked Mr. Meehan for his informative address.

Meeting closed at 10 P. M.

S. B. PEARCE, *Secretary-Treasurer*

MONTREAL BRANCH

The April meeting of the Branch was held in the Mount Royal Hotel on April 7.

The guest speaker of the evening was F. BLAKE of Sherwin Williams (Canada) Ltd. Blake's topic was "Evaluation of a Good Paint from Physical Aspects". It was mentioned that a good paint should have the following qualifications: Appeal with respect to colour and also to act as a protective coating for both metal and wood. A film depicting the various types of paint manufactured accompanied the talk. The importance of blending the different dyes and ingredients used in the manufacture of paint products also was stressed.

The following applicants were elected to membership: ROBERT D'ESTERRE of the Behr-Manning Co., Brantford, Ont., and DR. J. KANE of Canadian Arsenals Ltd., Quebec City.

IMMEDIATE PAST PRESIDENT G. R. KING was presented with a Past President pin by JOHN T. REISENBURG, who thanked Mr. King on behalf of the Montreal Branch for the splendid work done during his term of office.

The meeting for May was held on the 5th.

Guest speaker of the evening, MANSON GLOVER of the Glover Coating Company, Boston, Mass., spoke on "Corrosion Resistant Tank Linings for Plating Rooms". Mentioned during the speaker's talk were tank linings of thermo-setting materials such as phenolic resins, polyesters and Bakelite; then followed natural rubber, Neoprene and Koroseal. Neoprene is superior to rubber for strength and its ability to withstand heat, but where acids are concerned, rubber lined tanks are recommended. Koroseal linings are standard for chromium plating because of low cost and ease of repair. It is to be noted that Koroseal will bulge at a temperature of 150°, and when cool will not return to its original state.

Delegates to the Philadelphia Convention were elected as follows: CHAIRMAN J. J. ROCHE, J. D. FAIRBAIRN, J. H. CHARLES, with DR. J. KANE, J. CARRIQUE, P. M. COADY as alternates.

The meeting for June was held on June 9.

Through the courtesy of the Imperial Oil Company of Canada and the Minnesota Mining and Manufacturing Company, two films were shown.

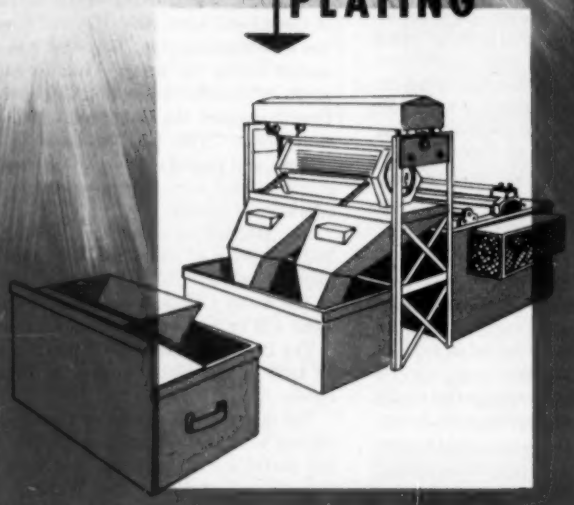
The first, titled "Frontier Outpost", furnished by Imperial Oil, dealt with life and industry in Canada's newest province, Newfoundland. Foremost industries of this new land appear to be fishing and trapping.

The second film, supplied by the Minne-

LEA-RONAL

Bright Copper

FOR BARREL PLATING



Speed

Lea-Ronal Bright Copper can be plated at current densities 2 to 3 times higher than conventional barrel formulations.*

Savings

- in copper cyanide
- in burnishing
- in floor space
- in additional equipment

*One manufacturer, formerly barrel plating small steel stampings with 2.5 amperes per gallon of solution, changed to Lea-Ronal Bright Copper and has been able to obtain brighter deposits with 6 to 7 amperes per gallon of solution.

Other advantages of Lea-Ronal Bright Copper for Barrel Plating are (1) excellent anode corrosion resulting in minimum metal cyanide addition; (2) bright, soft ductile deposits; (3) maximum bath efficiency with longer bath life (carbonate build-up not detrimental); (4) many items being racked and plated in still tanks can now be plated satisfactorily in barrels with Lea-Ronal Bright Copper.

Just as operators of still tanks have found Lea-Ronal Bright Copper (utilizing Lea Copper Glo) extremely worthwhile, so will you find Lea-Ronal Bright Copper for your barrel plating also much more effective than conventional barrel solutions and methods. Why not place a trial order and make your own comparisons?

Lea-Ronal Bright Copper for barrel plating (for which Lea Copper Glo is an essential ingredient) is marketed exclusively through The Lea Manufacturing Co., 16 Cherry Avenue, Waterbury 20, Connecticut. Your inquiry should be addressed to that company.

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"No natural or mechanical force can so completely destroy an established company and its business as new and improved methods and materials in the hands of an enlightened competitor."

What greater testimony than this can be offered in support of the value and necessity of research?

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"YOUR BEST BET'S THE AES RESEARCH PROGRAM"

Branch News

sota Mining and Manufacturing Company titled "The Polished Blade", showed the different uses abrasive belts were being put to in the finishing of high precision parts in the aircraft industry. After the showing of the films, MR. BUD UNDERHILL of the 3M firm gave a brief talk on some of the products manufactured by Minnesota Mining and Manufacturing Co.

JOHN T. REISENBURG, JR., *Secretary*

ROCKFORD BRANCH

The Branch held its Annual Stag picnic at the S. M. & S. F. park again this year. Sixty-five members and friends were there to enjoy the delicious ham dinner arranged for and served by the picnic committee composed of CHAIRMAN HERMAN REWERTS, ROBERT CAMPBELL, BEN MOSBACH, and CLAYTON JOHNSON.

At the June meeting LEONARD WEEG proposed that the Branch invite as guests to the annual picnic the representatives of the various suppliers that have so greatly aided the Society. The proposal was accepted unanimously.

The entertainment for the evening included a barber shop quartet.

In September the Branch will hold its annual Plae Day at the Beloit Country Club in Beloit, Wis.

ROGER JOHNSON, *Secretary*

SYDNEY BRANCH

Twenty-five members and visitors were present at the 93rd general meeting held at the Trust Building, King and Castlereagh Streets, Sydney, on July 9.

This meeting took the form of an interesting film night, and the following films were made available by the courtesy of the Australian General Electric Co.

"Jet Propulsion"—which explains the working principles of the modern jet plane. "Clean Waters"—shows the importance of clean natural waters to the community, and how the menace of polluted water is overcome. "Shining Rails"—shows the application of electricity to railway operations with special reference to electric and diesel-electric locomotives and control of train movements. "Safety in Factories"—deals with many hazards that should be overcome.

A talk on the Melbourne Convention was given by MESSRS. MURPHY, ARMSTRONG and MILLWARD. This was followed by a talk by MR. E. MERRIMAN on his recent trip abroad.

The 94th general meeting had a Technical Session given by MR. BEN ARMSTRONG, A.S.T.C. (Chem. Eng.), A.A.C.I. Lecturer at the School of Metallurgy at the N. S. W. University of Technology. This talk was very informative and dealt with "The Principles and Theory of Alloy Plating".

B. W. BRIDGEMENT, *Secretary-Treasurer*

Hammond OF KALAMAZOO
GOOD MACHINERY SINCE '82

MODERN Self Contained GRINDER-POLISHER

Hammond Variable Speed (1500 to 3000 RPM) Polishing and Buffing Lathe. Models up to 50 HP available.

Hammond Cyclone Duskolector. One of a wide line of Cyclone and Filter Types.

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Write for Catalog No. 60 showing America's most modern and complete line.

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SEE US AT BOOTH 1150—NATIONAL METALS EXPOSITION

Branch Speakers List 1953-1954

Addition to list published in August issue

(c) Expenses paid by Company
(b) Expenses paid by Branch
(b or c) Expenses to be negotiated

METAL & THERMIT CORPORATION (c)
P. O. Box 471, Rahway, N. J.—East of the Mississippi River
DR. FREDERICK A. LOWENHEIM, Supervisor, Electrochemical Research
Subjects:
1. *Alkaline Tin Plating*
2. *Tin-Zinc Alloy Plating*
3. *Tin Alloy Plating, including Tin-Zinc Tin-Nickel and Bronze*

THE PFAUDLER CO. (c)
1000 West Avenue, Rochester 3, N. Y.—East and North Central
W. F. SWANTON, Chemical Process Engineer
Subjects:
1. *Recovery of Plating Salts from Rinse Waters*
2. *Corrosion Resistant Equipment*

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Subject:
Controlling Corrosion in the Plating Room

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Lick HEAVY DUTY DRAWING COMPOUND REMOVAL with . . .

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—a low foaming, high powered washing machine cleaner

COWLES TECHNICAL SERVICE gladly furnished on request

Charge your washing machine with Cowles WM for quicker and better removal of drawing compounds and other soils. WM cleans all types of work from shells to laundry machine tubs. WM, a highly alkaline cleaner, gives you peak detergency along with a minimum of foaming for faster, more efficient longer life cleaning solutions.

We will be glad to send you complete technical information.

COWLES CHEMICAL COMPANY
METAL CLEANER DEPARTMENT
7016 Euclid Avenue • Cleveland 3, Ohio

Membership Report of the A. E. S.

Elections

ADELAIDE: S. Hryhorciw, W. Pietuszko
HARTFORD: L.W. Bowen, A.R. Burman
KANSAS CITY: Ralph R. Dawkins, R.C. Garland, E.D. Hetrick, T.Sawyer
MONTREAL: Robert D. D'Esterre, Dr. J. Kane, H. T. Wilson
PHILADELPHIA: B.P. Flashman, G.W. Irwin, F.J. Mojta, H.R. Wilk
SYRACUSE: C. F. Harris, G. S. Jones
SYDNEY: Frederick R. Barnett, David Facer, Lawrence Heath, S.C.G. Moon
WESTERN ONTARIO: H. W. Lenson
MEMBER-AT-LARGE: Joseph Robert, Bruxelles, Belgium

Reinstatements

CHICAGO: W. D. Jeffries
DETROIT: Edmund J. Quinlan
SYDNEY: G. W. Edwards, K. J. Hacker
SYRACUSE: R. C. Taylor, T. Taylor

Transfers

W. D. Jeffries to New York from Chicago; Merritt J. Lillis from Detroit to Chicago; A. G. Russell to Twin City from Chicago; August B. Hoefer from Philadelphia to Detroit; E. L. Huber to Columbus from Detroit; R. K. Martin to Grand Rapids from Louisville; Philip J. Lo Presti from New York to Philadelphia; Lawrence N. Thomas to Boston from Philadelphia; S.S. Johnston from Pittsburgh to Member-at-Large; G. S. Woodruff to Jackson-Lansing from Pittsburgh

Resignations

ADELAIDE: B. L. Cheeseman, W. Fischer, L. Fromm
CHICAGO: Mary E. Loftus
DETROIT: Stanley E. Beauregard, K.R. Branion, Harry DeLoy, W. S. Fagley, C. D. MacPherson, W. H. Schan
PHILADELPHIA: Charles W. Moleton

Suspensions

LOUISVILLE: Harvey R. Cross, Lee O. Dunavan, Linford L. Jones, Angus N. McDonald, William Mooser

MELBOURNE: D. J. Broadley, F. D. Carroll, C. Collings, J. Cutler, L. J. Houghton, F. J. King, G. Little, G. R. Lunn, J. V. McCarthy, L. P. Nation, J. L. Perdix, B. T. Taylor, A. G. Villiers
SPRINGFIELD: John Horrigan
TOLEDO: Earl Applegate, Earl Brillhart, Clifford Cole, Joseph Di Salle, Wendlin J. Ehman, Jack H. Fries, Joseph Gorman, William Hilfinger

Deaths

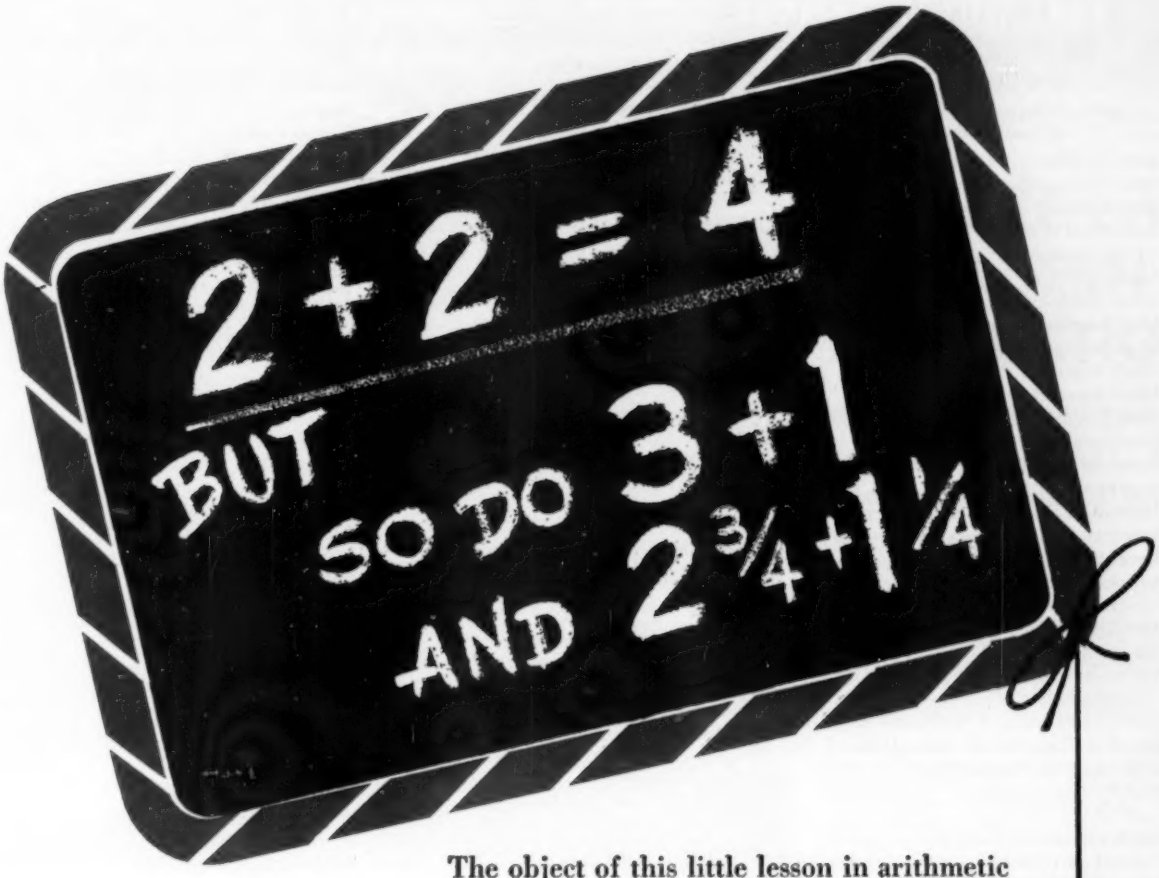
TWIN CITY: Albert A. Joyner

Membership Competition

BRANCH	Membership Apr. 1, 1953*	New Members	Net Change Membership	Per Cent Net Change
First Group				
Los Angeles	236	23	+16½	+ 7.0
Philadelphia	198	14	+ 7½	+ 3.8
Milwaukee	164	6	+ 5½	+ 3.4
Newark	251	7	+ 6½	+ 2.6
Cleveland	236	8	+ 6	+ 2.5
New York†	352	16	+ 6	+ 1.7
Chicago	477	14	+ 7½	+ 1.6
Pittsburgh	142	3	+ 1	+ 0.7
Detroit	504	12	+ 2½	+ 0.5
Toronto	146	2	0	0
Boston	155	..	.....	.....
Bridgeport	158	..	.....	.....
Grand Rapids	173	..	− 1	− 0.6
Waterbury	130	5	− 1	− 0.8
Hartford	151	5	− 1½	− 1.0
Melbourne	169	12	− 6	− 3.6
Second Group				
Montreal	80	8	+ 8	+10.0
Baltimore-Washington	93	7	+ 5½	+ 7.9
San Francisco	74	8	+ 4	+ 5.4
Dayton	76	6	+ 3½	+ 4.6
St.Joseph Valley	78	3	+ 2	+ 2.6
Rochester	107	4	+ 2½	+ 2.3
Saginaw Valley‡	103	5	+ 2	+ 1.9
Providence-Attleboro	95	1	0	0
St. Louis	109	3	0	0
Buffalo	106	1	− 1	− 0.9
Indianapolis	105	..	− 1	− 1.0
Twin City	71	1	− 1	− 1.4
Syracuse	128	8	− 3	− 2.3
Cincinnati	92	3	− 3½	− 3.8
Sydney	82	6	− 4	− 4.9
New Haven	100	..	− 5½	− 5.5
Third Group				
Springfield	57	7	+ 6	+10.5
Western Ontario	22	2	+ 2	+ 9.1
Wichita	41	3	+ 3	+ 7.3
Kansas City	46	6	+ 2	+ 4.3
Rockford	63	2	+ 2	+ 3.2
Columbus	52	1	+ ½	+ 1.0
Southeastern	50	2	0	0
Dallas-Fort Worth	53	..	.....	.....
Hamilton	25	..	.....	.....
Houston	42	..	.....	.....
Jackson-Lansing	61	..	.....	.....
Lancaster	69	..	.....	.....
Adelaide	52	4	− 1	− 1.9
Allentown-Reading	53	..	− 4	− 7.5
Toledo	56	1	− 9	−16.1
Louisville§	44	..	− 7½	−17.0
Outside Competition				
Portland	...	18	.....	.....
At Large	138	16	+13½	.....
Total A. E. S.	6,065	253	+83½	+ 1.4

Active Membership, August 31, 1953 6,180

*Subject to correction. †, ‡, §Winners in first, second and third groups, respectively of 1952–1953 membership competition.



The object of this little lesson in arithmetic is to prove that there are more ways than one to come to a conclusion. But, when it narrows down to Rectifiers, there is only one conclusion you can make. And that is... Green Rectifiers are unbeatable for quality, performance, and service.

IF YOU WANT THE BEST... Buy Green!

W. GREEN ELECTRIC COMPANY, INC.

SELECTRO PLATERS AND ALL TYPES OF RECTIFIER EQUIPMENT

GREEN EXCHANGE BUILDING 130 CEDAR STREET NEW YORK 6, N. Y.

RECTIFIER (G) ENGINEERS

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As of September, 1953

(Figures in parenthesis indicate number of memberships held)

Accurate Electro-Plating, Inc.
Acme Galvanizing, Inc.
Acme Plating Company, The
Acme Steel Company
Adolph Plating, Inc.
Advance Plating Company, The
Aetna Electroplating Company
Alert Supply Company
Allen-Bradley Company
Allied Industrial Products, Inc.
Allied Research Products, Inc.
Alsop Engineering Corporation
Aluminum Company of America
American Anodizing & Plating Company
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American Wire Fabrics Corporation
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Armco Steel Corporation
Arnold, Schwinn & Company
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Arrow Plating Company, Inc.
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M. E. Baker Company
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Bart-Messing Corporation
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Beacon Supply Company
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Belke Manufacturing Company
Bell & Howell Company
Bell Telephone Laboratories, Inc.
Bendix Prods. Div., Bendix Aviation Corp.
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Bethlehem Steel Company (2)
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Briggs Manufacturing Company
Brookline Electro Platers, Inc.
Bruce Products Corporation
Buckeye Products Company, The
Buckingham Products Company
Chandeysson Electric Company
Chase Brass & Copper Company
Chemical Corporation, The
Chicago Electro-Platers Institute
Chicago Roller Skate Company
Chicago Thrift-Etching Corporation
Christie Plating Company
Chrome-Rite Company (2)
Chromium Corporation of America
Chromium Process Company, The
Chrysler Corporation (2)
Cinch Manufacturing Corporation
Clayton Mark & Company
Cleveland Graphite Bronze Company, The
Clinton Company, The
Clinton Supply Company, Inc.
Codman, F. L. & J. C., Company
Continental Can Company
Corona Corporation
Cowles Chemical Company
Crane Company
Croname, Incorporated
Crown City Plating Company
Crown Cork & Seal Company
Crown Rheostat & Supply Company
Cutler-Hammer Company

Darco Dept., Atlas Powder Company
Davies Supply & Manufacturing Company
Daystrom Furniture Div., Daystrom, Inc.
Detroit Plating Industries
Diamond Alkali Company
Diamond Plating Company
Diversey Corporation, The
Dixie Electro Plating Company
Doehler-Jarvis Corporation (2)
Donald Sales & Mfg. Company
R. R. Donnelley & Sons Company
E. I. duPont de Nemours & Company
Dura Div., Detroit Harvester Company
Dura-Chrome of Chicago, Inc.

Eastman Kodak Company (2)
Eaton Manufacturing Company
Ekco Products Company
Electric Auto-Lite Company, The (2)
Electrolux Corporation
Electro-Platers Company
Enthone, Inc.
Erie Plating Company

Felt & Tarrant Manufacturing Company
Finishing Publications, Inc.
Ford Motor Company (5)
Formax Manufacturing Company
Frigidaire Div. General Motors Corp.

General Electric Company
General Motors Corporation (5)
Gerity-Michigan Corporation
Gorham Manufacturing Company
Graham, Crowley & Associates, Inc.
Graham Plating Works
Grand Plating Company
Grand Rapids Plating Company
Great Lakes Industries, Inc.
Gumm Frederick, Chemical Company

C. Hager & Sons Hinge Mfg. Co.
Hall-Mack Company
Hamilton Watch Company
Hammond Machinery Builders, Inc.
Hanson-Van Winkle-Munning Co. (3)
Harding Manufacturing Company
Hardwood Line Manufacturing Company
Harshaw Chemical Company, The (3)
Haviland Products Company
Heil Process Equipment Corporation
Heywood-Wakefield Company
Houdaille-Hershey Corporation (3)
Howard Plating Industries, Inc.
Howell Company, The
Hub Plating Works
Hudson Motor Car Company
R. O. Hull & Company, Inc.
Hy-Grade Electroplating Company

Industrial Filter & Pump Mfg Co.
International Business Machines Corp.
International Nickel Co., Inc., The (5)
International Silver Company
James Plating Works, Inc.
Jones & Laughlin Steel Corporation

Kaynide Div., Kraft Chemical Co.
Keeler Brass Company
Kelly Plating Company, The
Knape & Vogt Manufacturing Company
Knapp-Monarch Company
Knight Plating Company
Kocour Company
Kohler Company
Kuehne Manufacturing Company

Lane Plating Works
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Lea Manufacturing Company, The
Leeds & Northrup Company
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Lyon, Incorporated

Maas & Waldstein Company
W. D. MacDermid Chemical Company
MacDermid, Incorporated
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R. C. Mahoney
P. R. Mallory & Company, Inc.
Manderscheid Company, The
Matchless Metal Polish Company, The
Mattatuck Manufacturing Company
Maurer Supply Company
McGean Chemical Company, The
Meaker Company, The
Mechanical Plating Company
Mercil Plating Equipment Company
B. Mercil & Sons Plating Company
Metalcraft Corporation
Metallon Products, Inc.
Metal Mouldings Corporation
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Michigan Bumper Corporation
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Minneapolis-Honeywell Regulator Co.
Mitchell-Bradford Chemical Co., The
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National Brass Company
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J.C. MILLER COMPANY

World's largest producers of *TRIPOLI BUFFING COMPOUNDS* . . . scientifically controlled from mines to finished product

SOURCE and MODERN PRODUCTION

Combine to supply you with the world's finest, most widely used line of buffing compounds

J. C. Miller Company

Due to the increased demand for both bar and liquid buffing compounds, the J. C. Miller Company has just completed new facilities for unlimited production. Now more and more manufacturers everywhere can be assured of receiving prompt delivery on their compound requirements; technical assistance and data from one of the nation's most completely equipped and staffed laboratories.

Liquimatic®

LIQUID BUFFING COMPOUND

LIQUIMATIC . . .

THE Liquid Buffing Compound

J. C. Miller Engineers are fully qualified through technical training and years of practical experience to demonstrate and recommend materials and methods for use in your plant — materials and methods that pay you big dividends in higher production and increased savings.

Our Buffing Engineers are equipped with portable Liquimatic demonstration kits which enable them to easily show you the savings that Liquimatic can effect in your plant — on your production line. This demonstration equipment is rapidly set up, requires no assistance from your help and the test can be made on hand lathes or automatic equipment using just a compressed air connection. The demonstration in no way impedes your normal production flow.

Here is a demonstration you should see regardless of past experience or whether or not you are using a liquid compound at present! We know that we can show you that we have achieved the maximum in performance through combining the very latest in equipment with the very best in compounds — Liquimatic. *This is the Liquimatic team — an unbeatable combination.*

Users of Tripoli powder the world over obtain their supply from the American Tripoli Corporation in Seneca, Missouri, where the only known deposit of this unusual material is located. A few of it's many users include manufacturers of buffing compositions, lacquer finishing compounds, automobile polishes, insecticides, etc. Perhaps you have a place for Seneca Standard Tripoli in your process. *Investigate its possibilities!*

EXTRUDED BAR COMPOUND

The J. C. Miller Company offers a complete range of all sizes and shapes of extruded tripoli bar compound. These extruded bars meet all the requirements and conditions of any job — large or small. Write for complete details.

"Seneca Standard" Tripoli is processed in Seneca, Missouri, U. S. A., and is used in all the leading industrial countries of the world.

AMERICAN TRIPOLI CORPORATION
SENECA, MISSOURI, U. S. A.

A Subsidiary of

Tripoli • Stainless steel compound • Lime finish
Cut and color • Chrome rouge • Greaseless
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Controlled Compounds for all Finishing Requirements

J. C. MILLER COMPANY — Grand Rapids, Michigan

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National Plating Company, Inc., The
National Screw and Manufacturing Co.
Nelson Chemicals Corporation
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Pheoll Manufacturing Company
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Platers Supply Company
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Plating Institute of Michigan, The
Plating Service Company
Precision Castings Company, Inc.
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Products Finishing
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Standard Plating Rack Company
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Standard Steel Spring Company (3)
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Sylvania Electric Products, Inc.

Talon, Inc.
Thomas Strip Div., Pittsburgh Steel Co.
Triple A Plating Company
Turco Products, Inc.
Turner Brass Works, The

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United Chromium, Inc. (2)
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United Platers, Inc.
United States Spring & Bumper Company

Van Der Horst Corporation of America
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Wagner Brothers, Incorporated
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Coating 218X protects all these...and more

THE MORE EQUIPMENT YOU USE IT ON
...THE MORE MONEY YOU CAN SAVE

It's getting to be the all purpose coating in plating plants—this green plastisol rack-coating. That's because there are so many pieces of equipment besides racks which have to combat corrosive conditions. They too need a coating with the flexibility, body, chemical inertness and toughness of Coating 218X.

Coating 218X withstands all plating, cleaning, anodizing solutions. Also vapor degreasing cycles. It absorbs bumps and abuse without chipping or damage. It's controllable in thickness from 3 mils to 3/16-inch.

So by all means protect racks with Coating 218X—you can't find a better way to reduce coating costs. But why not also take advantage of its durability *wherever* corrosion costs you money? Phone, write for help on applications.

UNICHROME Trade Mark **COATINGS for METALS**
Metallic ..... Organic ..... Decorative ..... Protective

Products of UNITED CHROMIUM, INCORPORATED

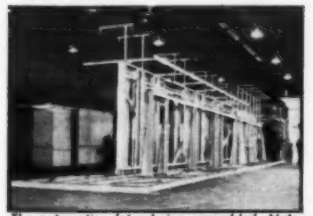
100 East 42nd St., New York 17, N.Y. • Detroit 20, Mich. • Waterbury 20, Conn. • Chicago 4, Ill.
Los Angeles 13, Calif. • In Canada: United Chromium Limited, Toronto, Ont.

It's a Revolution in Plating Automation

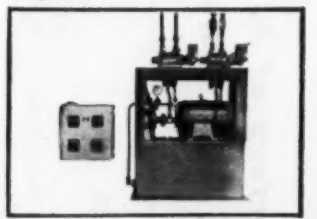
A complete new approach to automation in plating—

Fully Engineered-
Proven Principles-
Now in Plating Production

Central lubrication unit (1) at loading station, greases all moving parts while operating. Reciprocating carriage (2) is actuated by simple trouble-free cylinder (3). Decelerating cams (4) operate control valve (5) to assure smooth, long life operation.



The automatic plater being assembled. Note that all lubricated machinery is centrally located—not over tanks—for easy servicing and to preclude contamination of fluid in tanks. This unit is in three sections for economical transportation.



One electric motor supplies all power for the hydraulically driven automatic plater. The power unit and control panel can be installed at any convenient point in the plant for convenience in installation, servicing and operation.

CUTS LABOR — You load it and press the button — your Wagner does the rest.

CUTS DOWNTIME — All working parts are readily accessible for servicing — Built in sections for quick inspection and service without disturbing work or other sections.

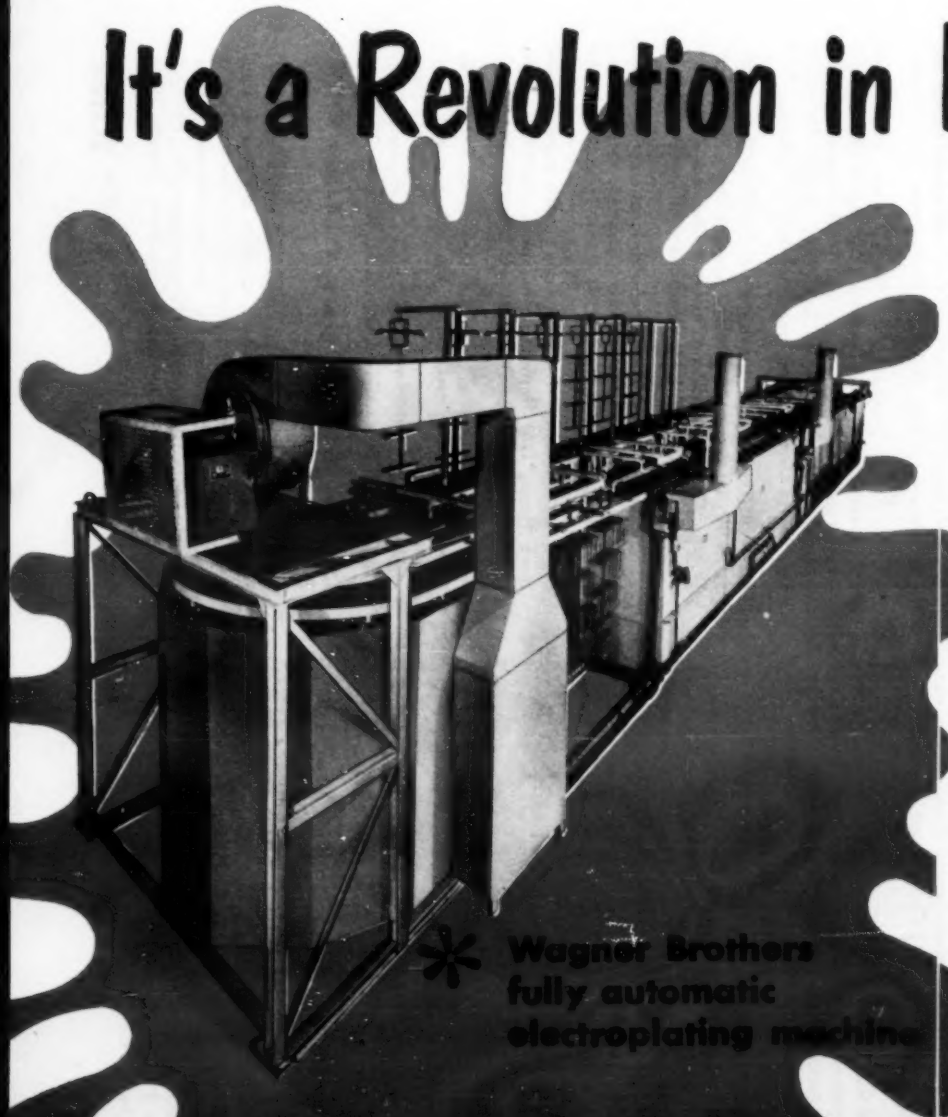
CUTS POWER NEEDS—A Wagner Fully Automatic operates on one motor of less than half the power needed for any other electroplating equipment of comparable capacity.

CUTS CONTAMINATION—No grease-loaded mechanisms are located above your tanks, eliminating a major plating problem.

CUTS SPACE NEEDS — Your Wagner Fully Automatic takes less floor space — less ceiling height. For example, it will handle a 48" rack under a 12-foot ceiling.

AND DOZENS OF OTHER cost cutting features. It's all new — It's fully proven — It's in production. It's Wagner Brothers Brand New Fully Automatic Plater.

Wire your nearest Wagner representative or call direct at once and get complete information on this revolutionary and efficient New Approach to electroplating automation.



Wagner Brothers fully automatic electroplating machine

Wagner BROTHERS, INC.

425 MIDLAND AVE. • DETROIT 3, MICH.

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BALTIMORE-WASHINGTON meets second Tuesday of each month with meetings in Baltimore at the Engineers' Club and in Washington, D. C., at the National Bureau of Standards. Secretary, Asaf A. Benderly, 1829 Summit Place, N. W., Washington 9, D. C.

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BRIDGEPORT meets second Friday of each month in Barnum Hotel. Secretary-Treasurer, Robert G. Parker, 25 Beverly Road, Trumbull 58, Conn.

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CHICAGO meets second Friday of each month at 6 P. M. at Western Society of Engineers, 84 E. Randolph Street. Secretary-Treasurer, Paul Glab, 882 N. Paulina Street, Chicago 22, Ill. Research Finance Committee Chairman, Charles Geldzahler, c/o Platers' Technical Service, Inc., 509 S. Wabash Avenue, Chicago 9, Ill.

CINCINNATI meets fourth Wednesday of each month at 7:30 P. M. in Engineering Society Headquarters, McMillan Street and Woodburn Avenue. Secretary, William Young, 7124 Montgomery Road, Cincinnati 36, Ohio. Research Finance Committee Chairman, C. R. Sorber, 2004 Connecticut Avenue, Cincinnati 24, Ohio.

CLEVELAND meets first Friday of each month in Hotel Carter at 8 P. M. Secretary-Treasurer, A. J. Lupien, 4408 Carnegie Avenue, Cleveland 3, Ohio. Research Finance Committee Chairman, to be appointed.

COLUMBUS meets first Friday of each month at 8 P. M. in Battelle Memorial Institute Auditorium. Secretary-Treasurer, Harry L. Moore, 505 King Avenue, Columbus 1, Ohio. Research Finance Committee Chairman, to be appointed.

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DETROIT meets first Friday of each month in Hotel Statler. Secretary-Treasurer, R. J. Racine, c/o Wyandotte Chemicals Corporation, Wyandotte, Mich. Research Finance Committee Chairman. New appointment to be made.

GRAND RAPIDS meets second Friday of each month at Fingers Restaurant at 7 P. M. for dinner; educational session at 8:15. Secretary, John Dykstra, 720 Delaware, S. E., Grand Rapids, Mich.

HAMILTON BRANCH meets third Thursday of each month in the Conference Room, West End Plant, Canadian Westinghouse Company, Ltd. Secretary, R. Burke, c/o Swift Devices, 14 George Street, Hamilton, Ontario, Canada.

HARTFORD meets third Monday of each month in Hotel Bond at 7:45 P. M. Secretary, Stanley Platoz, 26 Erwin Place, New Britain, Conn. Research Finance Committee Chairman, Frank W. Smith, 46 Cottage Street, Meriden, Conn.

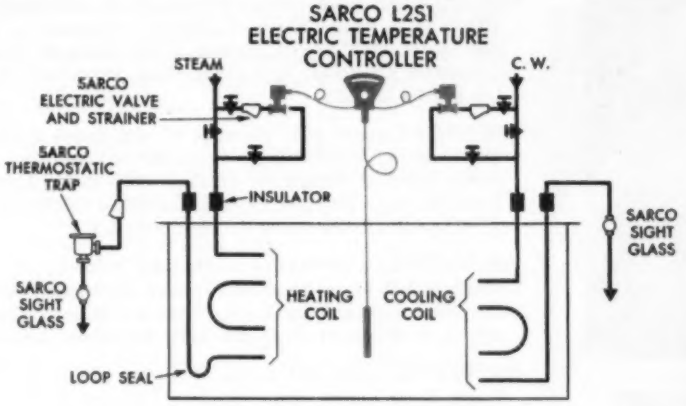
HOUSTON meets third Tuesday of each month at 6:30 P. M. in the Ben Milam Hotel, Houston. Secretary-Treasurer, C. A. Mattiza, P. O. Box No. 9312, Houston, Texas.

INDIANAPOLIS meets first Wednesday of each month at Fox Steak House, 1207 E. Washington Street. Secretary, Miss Edna Rohrabaugh, 816 Robert Street, Lafayette, Ind.

JACKSON-LANSING meets second Tuesday of each month alternating between Meadow Lark Inn in Jackson and Porter Hotel in Lansing. Secretary-Treasurer, E. J. Bosca, 411 Third Street, Jackson, Mich. Research Finance Committee Chairman, H. McKlueen, 3617 McCain Road, Jackson, Mich.

KANSAS CITY—Secretary-Treasurer, Olin K. Bock, 5317 W. 58th Street, Mission, Kansas.

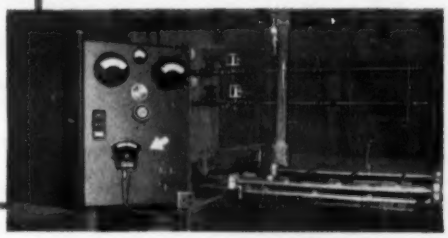
LANCASTER meets second Friday of each month at 8 P. M. September, December and April meetings are held at Hanover, York and Harrisburg, respectively; all other meetings at the Old Mill Inn, Lancaster, Pa. Secretary-Treasurer, Harry A. Saylor, 40 N. Poplar Street, Elizabethtown, Pa. Research Finance Committee Chairman, Harry Hovis, Lincoln Highway, West Lancaster, Pa.



One Sarco L2SI Electric Temperature Controller provides automatic control for *both heating and cooling* of anodizing and high speed nickel and chrome tanks.

Sarco Electric Temperature Controllers hold baths to within plus-minus 1°F. Temperature setting is easily changed by turning only one knob.

Brunswick Radio Corp., Chicago, enjoys all the benefits of automatic temperature control in its chromium plating operation with a Sarco Electric Temperature Controller.



It costs less than you think to install Sarco Electric Temperature Controls

. . . and you profit 4 ways!

Some platers believe that automatic temperature controls are expensive. Actually, Sarco automatic controls can be bought for as little as $130 a tank . . . *and often pay for themselves in just weeks!*

Here's How

Platers know that uneven bath temperature is one of the major causes of rejects and poor product quality. Many of them also know that a good deal of steam is wasted by manual attempts to keep temperatures where they belong. Furthermore, time lost in making these temperature adjustments with hand valves can be used more profitably in serving additional tanks.

With Sarco automatic controls desired temperatures are adjusted quickly by turning *one* knob and once adjusted stay where you want them . . . automatically. You profit 4 ways because:

1. **You improve product quality**
2. **You lower rejects**
3. **You save man-hours**
4. **You save steam and solutions**

Call in the nearby Sarco representative and have him show you just how little it costs to get all these benefits. For complete information on the advantages of Sarco plating controls, write for Technical Bulletin No. 6.

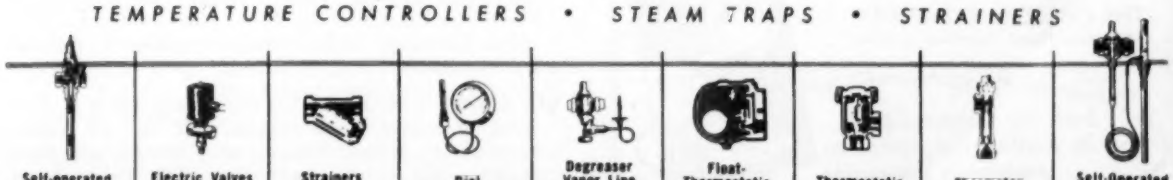
Some of the Many Companies Relying on Sarco Electric Temperature Controls

- Bendix Aviation Corp.
- Consolidated Razor Blade Co.
- General Electric Co.
- Howard Plating Industries, Inc.
- Mergenthaler Linotype Co.
- Pontiac Engraving & Electrotype Co.
- Ronson Art Metal Works
- Schick, Inc.
- Southern Gravure Service, Inc.
- The Upjohn Co.
- U.S. Electric Mfg. Co.
- United States Steel Corp.
- Western Electric Co.
- Westinghouse Electric Corp.

SARCO SAVES STEAM

SARCO COMPANY, INC., Empire State Building, New York 1, N. Y.
Sarco Canada, Ltd., Toronto 8, Ontario . . . Represented in Principal Cities

TEMPERATURE CONTROLLERS • STEAM TRAPS • STRAINERS



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LOUISVILLE meets third Thursday of each month in Room 119, Speed Scientific Building, University of Louisville. Secretary-Treasurer, Joseph G. Sterling, 1169 Keller Avenue, Louisville, Ky. Research Finance Committee Chairman, T. K. Allison, 2502 Manchester Rd., Louisville 5, Ky.

MELBOURNE, AUSTRALIA meets third Thursday of each month at 8 P. M. in Metallurgy Theatre, Melbourne Technical College, 124 Latrobe Street. Honorary Secretary-Treasurer, S. B. Pearce, G. P. O. Box 4591, Melbourne, Australia.

MILWAUKEE meets first Friday of each month in the East Room, Hotel Ambassador. Secretary-Treasurer, E. E. Piellusch, 2921 S. 90th Street, West Allis 14, Wisc. Research Finance Committee Chairman, to be appointed.

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NEW YORK meets second and fourth Fridays of each month in the Statler Hotel. Secretary-Treasurer, George Schore, 150 Bennett Avenue, New York 33, N. Y. Research Finance Committee Chairman, Milton Nadel, 41–15 50th Avenue, Long Island City 4, N. Y.

PHILADELPHIA meets fourth Friday of each month in Harrison Laboratory Building, University of Pennsylvania, 34th and Spruce Streets (unless otherwise stated). Secretary, I. William Marcovitch, 1434 Lardner Street, Philadelphia 24, Pa. Research Finance Committee Chairman, to be appointed.

PITTSBURGH meets second Thursday of each month in the Avon Room of the Sheraton Hotel. Secretary, Wm. D. Wilson, 1167 Varner Road, Pittsburgh 27, Pa. Research Finance Committee Chairman, S. S. Johnston, c/o Weirton Steel Company, Weirton, W. Va.

PROVIDENCE-ATTLEBORO meets third Monday of each month in Providence Engineering Society Hall, 195 Angell Street, Providence, R. I. Secretary, Henry Shavier, 32 Hodges Avenue, Taunton, Mass. Research Finance Committee Chairman, Pierre B. Lonsbury, 78 North Avenue, Attleboro, Mass.

ROCHESTER meets third Monday of each month at the 40 & 8 Club, 933 University Avenue. Secretary, Edwin Wallin, 70 Peach Tree Road, Penfield, N. Y. Research Finance Committee Chairman, Cecil Thornton, 20 Lafayette Parkway, Rochester 10, N. Y.

ROCKFORD meets second Monday of each month in Faust Hotel. Secretary, Roger Johnson, 2202 Eleventh Avenue, Rockford, Ill. Research Finance Committee Chairman, David Stockton, The Udylite Corporation, 1943 Walnut Street, Chicago 12, Ill.

SAGINAW VALLEY meets for dinner at 6:45 P. M. and meeting at 8 P. M. at Zehnder's, Frankenmuth, Mich., second Wednesday of each month, September through May, except February. Secretary-Treasurer, Stewart Harger, 3214 Norwood Drive, Flint, Mich.

ST. JOSEPH VALLEY meets first Wednesday of each month at 8 P. M. in Elkhart Hotel, Elkhart, Ind. Secretary-Treasurer, Eugene Roth, 739 N. College Street, South Bend 28, Ind. Research Finance Committee Chairman, Ralph Brouwer, 361 Maple Avenue, Holland, Mich.

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SAN FRANCISCO meets second Thursday of each month, alternating between St. Julien Restaurant, 140 Battery Street, San Francisco, and El Curtola Restaurant, 510 17th Street, Oakland. Secretary-Treasurer, Horace J. Smith, 319 Alta Loma Drive, South, San Francisco, Calif. Research Finance Committee Chairman, to be appointed.

SOUTHEASTERN meets second Friday of each month at the Belmont Steak House, Atlanta, Ga. Secretary-Treasurer, Charles A. Collings, P. O. Box 1088, Atlanta, Ga.

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SYDNEY, AUSTRALIA meets second Thursday of each month at 7:30 P. M. in the Trust Building, King and Castlereagh Streets. Secretary-Treasurer, B. Bridgement, 19 Adelaide Street, Belmore, Sydney, N. S. W., Australia.

SYRACUSE meets third Monday of each month in Richard's Restaurant. Secretary, Lindley Wood, 1329 Bellevue Avenue, Syracuse 4, N. Y. Research Finance Committee Chairman George W. Cavanaugh, 129 Kenwood Avenue, Syracuse 8, N. Y.

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TWIN CITY meets first Monday of each month, October through June, in the Covered Wagon (Lodge Room), 114 S. 4th Street, Minneapolis, Minn., with dinner at 6:30 P. M. and business and technical session at 8:00 P. M. Secretary-Treasurer, Robert L. Buckley, c/o Industrial Chemical & Equipment Company, 205 11th Avenue So., Minneapolis 15, Minn. Research Finance Committee Chairman, to be appointed.

WATERBURY meets second Thursday of each month in Elton Hotel. Dinner, 6:30 P. M., meeting, 8 P. M. Secretary Treasurer, Spencer L. Henn, P. O. Box, Drawer B, Cheshire, Conn.

WESTERN ONTARIO meets third Friday of each month in William Pitt Hotel, Chatham, Ontario. Secretary-Treasurer, K. W. Farquhar, c/o Wallaceburg Brass, Ltd., Wallaceburg, Ontario, Canada.

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Pressure Blast Application #308

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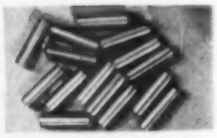

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INDUSTRIAL PACKAGING AND MATERIALS HANDLING EXPOSITION at Boston Mechanics Building, October 20–22, 1953.

NATIONAL PAINT, VARNISH AND LACQUER ASSOCIATION. Annual Convention and Paint Industries Show, Chalfonte-Haddon Hall, Atlantic City, N. J., October 26–30, 1953.

GRAND RAPIDS BRANCH, A. E. S. Annual Ladies' Night on November 6, 1953 at Finger's Restaurant.

SAGINAW VALLEY BRANCH, A. E. S. Past Presidents' Night on November 11, 1953 at Zehnder's, Frankenmuth, Mich.

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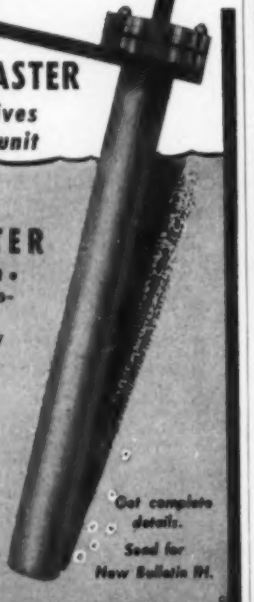

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